MISSOURI BOTANICAL GARDEN BULLETIN

VOLUME V
WITH 29 PLATES
1917

ST. LOUIS, MISSOURI
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

MISSOURI BOTANICAL
GARDEN LIBRARY

SHOUT
SHARE
IT

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. V JANUARY, 1917 No. 1

MISSOVRI BOTANICAL GARDEN
1889

CONTENTS

	Page
Report of the Officers of the Board - - - -	1
Twenty-eighth Annual Report of the Director - -	4
Statistical Information - - - - - - -	25

ST. LOUIS, MO.
1917
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

Edward C. Eliot.

George C. Hitchcock.

P. Chouteau Maffitt.

Edward Mallinckrodt.

Leonard Matthews.

William H. H. Pettus.

Philip C. Scanlan.

John F. Shepley.

EX-OFFICIO MEMBERS

Edmund A. Engler,
President of The Academy of Science of St. Louis.

Frederic A. Hall,
Chancellor of Washington University.

Henry W. Kiel,
Mayor of the City of St. Louis.

Benjamin P. Stromberg,
President of the Board of Public Schools of St. Louis.

Daniel S. Tuttle,
Bishop of the Diocese of Missouri.

E. F. Finney, Assistant Secretary.

Missouri Botanical Garden Bulletin

Vol. V St. Louis, Mo., January, 1917 No. 1

REPORT OF THE OFFICERS OF THE BOARD

To the Board of Trustees of the Missouri Botanical Garden:

We submit for your consideration a statement of the financial transactions for the year ending December 31, 1916.

The income from rentals and investments exceeded that of 1915 by $7,660.94, and vacancies during the year amounted to $2,287.00. However, at the present time there is but one vacant building, the rental of which is $1,800.00 per annum.

A piece of income property, known as No. 211-12 North Levee, having a frontage of 49 feet by a depth of 95 feet, was disposed of for $15,000.00, and the residence property at the northeast corner of Flad and Tower Grove Avenues—fronting 100 feet on Flad Avenue by 123 feet on Tower Grove Avenue—was sold for $6,250.00.

The improvement of the tract of land at Kingshighway and Arsenal Street, known as Shaw's Arsenal Street Addition, which contains about twelve acres, has been completed, and about 200 feet has been sold. The tract of land west of Tower Grove Avenue, known as Shaw's Vandeventer Avenue Addition, containing about 5,500 front feet, is likewise being improved, and about 600 feet has been disposed of.

A piece of property at the northeast corner of Grand Avenue and Morgan Street, fronting 163 feet on Grand Avenue, and containing a one-story building occupied by stores, cafes, etc., was bought for $160,000.00, the following property being transferred in partial exchange: two pieces of ground on Grand Avenue—one, being 232 feet front by a depth of 266 feet on Shaw Avenue, for $50,000.00, and the other, 55 feet front by a depth of 200 feet on De Tonty Street, for $10,000.00.

Sales of residence property during the year were as follows:

Lafayette Avenue Addition	1,883 front feet	$111,090 00
Arsenal Street Addition	204 front feet	8,215 00
Vandeventer Avenue Addition	620 front feet	20,020 00
Flora Boulevard Subdivision	242 front feet	14,600 00
		$153,925 00

The new range of greenhouses, begun in 1915, and on which $62,379.42 was paid that year, was completed at an additional expense of $9,429.73, making the total cost of this range $71,809.15. This is an extremely low figure for such a range of houses and is partially due to much of the work having been done by the Garden instead of through contract, and also to the major portion of the houses having been erected before the existing advance in prices of material and labor. If the houses had to be erected during the coming year, they would certainly cost from 50 to 60 per cent more.

Mr. A. D. Cunningham, Secretary to the Board since its organization in 1889, died on December 25. For nearly twenty-eight years Mr. Cunningham was a faithful and conscientious administrator of the business of the Board, and the Board wishes to formally record its appreciation of his services and a keen realization of its loss in his death. Mr. E. F. Finney has been elected Assistant Secretary.

Three of the bequests provided for in Mr. Shaw's will have been carried out: the annual flower sermon, the gardeners' banquet, and the Trustees' banquet.

For an itemized account of the receipts and disbursements, your attention is called to the following statement:

INCOME:		
Rentals (net)		$161,939 82
Interest and dividends		19,901 00
Total income		$181,840 82
LESS — ADMINISTRATION AND UPKEEP EXPENSES:		
Commissions on bonds and leases	$1,225 00	
Improvements	1,654 13	
Insurance	7,366 19	
Interest paid	2,364 76	
Legal expense	728 20	
Office expense	1,912 17	
Office salaries	5,009 98	
Repairs	4,094 29	
Taxes	40,375 19	64,729 91
		$117,110 91

LESS — ANNUAL BEQUESTS:			
Flower sermon, gardeners' banquet, and trustees' banquet			1,600 00
Income available for upkeep of Garden			$115,510 91
DISBURSED AS FOLLOWS:			
Garden Account —			
Fuel		$ 5,373 75	
Labor		33,196 57	
Plants and seeds		1,954 20	
Publications		3,185 28	
Repairs and supplies		4,917 00	
Stable expense		716 91	
		$49,343 71	
Herbarium —			
Expenses	$2,587 00		
Salaries	3,890 57	6,477 57	
Library —			
Expenses	$1,647 35		
Salaries	2,837 77	4,485 12	
Research and Instruction —			
Expenses	$ 5,671 97		
Salaries, fellowships, and scholarships	11,235 15	16,907 12	
Garden Office —			
Expenses	$2,074 95		
Salaries	9,186 56	11,261 50	88,475 02
			$27,035 89
DEDUCT — GARDEN IMPROVEMENTS:			
New Plant House (balance)		$9,429 73	
Wrecking and reconstructing old range, etc.		9,998 58	
Gate Lodge, remodeling		1,979 23	
General improvements		2,998 82	24,406 36
Excess of income over expenditure for year ending December 31, 1916			$ 2,629 53

Respectfully submitted,

EDWARDS WHITAKER, President.

Attest:

E. F. FINNEY, Assistant Secretary.

TWENTY-EIGHTH ANNUAL REPORT OF THE DIRECTOR

Gentlemen:

I have the honor to submit herewith the twenty-eighth annual report of the Director.

Although the year 1916 has seen no single large improvement similar to the new range of greenhouses, practically completed in 1915 and described at length in my last annual report, there have, nevertheless, been a considerable number of changes which will ultimately have quite as important an effect upon the Garden as the addition of new display houses. The first thing to be mentioned in this connection is the removal of the old range of greenhouses which has stood for so many years to the north of the water garden. Some of these houses were erected by Mr. Shaw, and up to five years ago, with the exception of the Linnean house, they provided the entire area of glass devoted to the public display of plants. The old palm house, with its adjoining wings, had become so unsafe that it was necessary to close it to the public, and it was barely possible to maintain the plants in the other old houses even with constant repairs. With the completion of the second new range of greenhouses which so amply provided for the collections maintained in these old houses, they were no longer necessary, and for every reason it seemed desirable to remove them. This was accordingly done, but a part of the houses was re-erected with concrete foundations and walls back of the north wall, where they now afford much-needed growing and propagating space and more than replace the growing houses which constituted a part of the old range. The addition of these new growing houses necessitated the construction of a new valve chamber and a concrete tunnel in which to convey the steam pipes from the service tunnel, as well as a large amount of grading, installation of drains, etc. The area formerly occupied by the old range is to be the site of a new rose garden, the plans for which are now prepared, and it is expected that this new garden will be established next spring.

The removal of the greenhouses necessitated providing new quarters for the various shops, as well as additional storage sheds, which had formerly been in the court bounded by the old greenhouses. There have accordingly been built, in the vicinity of the central heating plant, adequate paint and carpenter shops, including storage sheds for glass, paint, and lumber. Two storage sheds, 125 × 25 feet, were likewise built of brick obtained from the old greenhouses, these being intended primarily for housing the larger apparatus, such as carts, spray pumps, sprinklers, etc. However, the destruction by fire of the old stable and barn necessitated converting one of these sheds into a new stable, for which it was admirably adapted, and the removal of this department to the new location, which had long been contemplated, has proved to be most satisfactory. While the destruction of the old stable itself was no great loss, the entire winter's supply of hay and a considerable amount of other feed, as well as harness, two wagons, certain farm implements, and other minor apparatus, were also destroyed, so that the actual money loss, exclusive of the building, was about $1,500. In this connection it might be mentioned that during the year the Garden was visited by two of the most destructive storms since the cyclone of 1896. In June a hail-storm did very considerable damage to the glass, and in September a windstorm produced even greater loss, since not only were a large number of trees and shrubs injured, but there was also material damage to some of the greenhouses and other structures in the Garden.

The area occupied by the old herbaceous tract has, during the past few years, gradually been converted into an economic garden where various farm crops and plants of practical use have been grown. No definite plan for this region had ever been laid out, but during the past year the area has been graded, and about one-half made to conform with a landscape design admirably adapted to the purposes of such a garden. While there still remains a great amount of work to be done here, enough progress has been made to indicate what the final condition is to be, and it is hoped that during the coming year the plans may be carried to completion. This economic garden has proved to be one of the most attractive and important outdoor gardens, particularly for the school-children, and when completed it will afford a demonstration ground where may be found various examples of vines, shrubs, and flowering plants, adapted for use in the vicinity of St. Louis.

Another improvement has been the providing of an exit to the north from the Italian garden. With the construction of the new range of greenhouses it became desirable to have a ready means of communication to and from this house and the Italian garden. This necessitated building concrete retaining walls and a stairway, as well as providing the necessary connecting walks, and it is now possible to pass directly from the Italian garden to the new greenhouses without going through the palm house.

The opening up of the Garden in the vicinity of the new plant house has necessitated much grading, construction of drains, replanting, etc., and a start has been made towards providing pools back of the pergola and the new range, which will ultimately afford additional space for the growing of water-lilies. The walks which will connect the economic garden with the arboretum are still to be built and a considerable amount of clearing up and planting to be accomplished.

The piece of property acquired by the Board in 1914, on which stood the old Shaw School, had never been graded or planted after the destruction of the schoolhouse, and, while not in the improved part of the Garden, it presented a very unsightly appearance, particularly since it was in such a conspicuous place. During the year this area has been filled and graded, and a good start made towards the planting, so that it now presents a satisfactory appearance.

In addition to the usual monthly floral displays and other attractions provided for the public, two special features were offered in the year 1916 which are worthy of mention. The celebration throughout the country of the three-hundredth anniversary of Shakespeare's death warranted the Garden in providing, during the annual convention of the Drama League held in St. Louis in April, a Shakespearean Garden. This, because of its design and the plants shown, was — for an indoor garden — the most elaborate thing of the kind ever attempted. As it has been described in detail in the BULLETIN, it need not be referred to further, aside from the fact that it attracted much attention, not only locally but throughout the country, and numerous inquiries for information respecting the design and contents of our Shakespearean exhibit were answered.

In October there was displayed in the old museum a collection of plans, drawings, and photographs of some of the most recent landscape work in this country. Many of the best-known landscape architects in the United States, together with the departments of landscape architecture of various schools and universities, contributed to this exhibit, and it proved both instructive and interesting, not only to landscape architects, engineers and gardeners, but to the general public as well.

An unusual amount of repair work, particularly painting, has been carried on during the year, and it may be said that the various structures at the Garden are in better shape than ever before. In addition to repainting the pergola and many of the greenhouses, and extensive repairs in the museum and old residence, the most important single item was the remodeling of the lodge house located at the Cleveland Avenue gate. Besides providing a cellar and a hot water heating system, putting in electric lights, bathroom, etc., numerous changes in the interior arrangement were made, and the entire house redecorated and made livable. The house is now occupied by the General Manager of the Garden.

Brief reference was made in my last annual report to the fact that the Garden was becoming more and more a source of information, not only to scientists and those interested in the growing of plants, but also to business concerns. The Garden has always been an institution to which people turned for what might be called botanical and horticultural information, but the European war has had such a profound effect upon manufacturing and other industries in this country that the necessity for substituting new materials and methods has created an unprecedented demand for technical information not readily accessible to the business man. As a consequence the Garden has, during the past year, devoted much time and attention to furnishing information of this character. In addition to an increasing demand for the identification of plants, seeds, and woods — many of which, because of their medicinal or other value, are of great importance commercially — which the extensive herbarium and library of the Garden make possible, there have been numerous requests concerning the various aspects of mushroom growing, both by commercial concerns and private individuals, and a demand for information respecting means of preventing the growth of fungi on commercial products subject to mold. The impossibility of obtaining the usual disinfectants, or their prohibitive price, has made it necessary for many concerns to turn to the scientific staff at the Garden for help.

An article in the BULLETIN, calling attention to a wood one-half the weight of cork, resulted in such a demand from manufacturers of artificial limbs, talking machines, piston rings, pith helmets, refrigerators, and from others using cork and insulating material, that the Garden took up the matter with several dealers in tropical lumber, and as a consequence the wood is now on the American market and is available for the various uses to which it is adapted. Special instructions have been furnished to parks, cemeteries, and private individuals for means of eradicating the unsightly green scums which appear during the summer on ponds and streams, and requests too numerous to mention concerning various minor technical points involving a use of the facilities of the Garden have been complied with. In addition there is a constantly growing demand of the citizens of St. Louis for information about the care of both indoor and outdoor plants, and trees and shrubs.

ATTENDANCE

The attendance for the year 1916 totaled 275,910, an increase of 35,407 over the previous year. It is hardly to be expected that this rate of increase will be maintained, although the gain for 1916 is nearly double that of 1915 and more than six times that of 1914. For the first time, since the Garden has been opened to the public on every Sunday, the number of visitors on that day exceeds those coming on week-days, and in fact the chief gain for the year is due to the increased Sunday attendance. Even in the years when the Garden was open but two Sundays, an average of 25 per cent of the total number of visitors for the year came on these two days, and on certain years nearly one-half of the yearly visitors came on the open Sundays. Consequently, the proportion of Sunday to week-day visitors is only just beginning to exceed that of the years when the Garden was open on two Sundays only.

ATTENDANCE FOR THE YEAR 1916

	Week-days	Sundays
January	1,866	3,272
February	2,698	3,121
March	3,887	4,985
April	11,686	23,508
May	15,071	14,941
June	14,783	11,300
July	9,688	7,205
August	13,092	5,595
September	11,820	17,120
October	15,362	13,423
November	24,912	34,582
December	4,255	7,738
	129,120	146,790
		129,120
TOTAL		275,910

ANNUAL BEQUESTS

The flower sermon, provided for in Mr. Shaw's will, was preached in Christ Church Cathedral by the Rev. George C.

Dunlop, Rector of Christ Church, Springfield, Illinois, on May 21, 1916.

The Twenty-seventh Gardeners' Banquet was held on the evening of December 1, 1916, at the University Club. Professor E. A. White, of Cornell University, spoke on "What Science Has Done for Floriculture."

The Banquet of the Board of Trustees of the Garden was held on the evening of December 28, 1916, at the Buckingham Hotel, on the occasion of the joint meeting of the American Philological Association and the Archaeological Institute of America. Mr. Frederic A. Hall acted as toastmaster, and following is the list of speakers and subjects:

Mr. Edward C. Eliot, "Henry Shaw"; Mr. Paul Shorey, "The Loneliest Man"; Mr. Frederick W. Shipley, "Sermons in Stones"; Mr. James H. Breasted, "Tatters"; Mr. William H. Holmes, "The Place of Archaeology in Human History"; Mr. Henry R. Fairclough, "The Pivotal State"; Mr. Andrew F. West, "Some Old Things in Human Life."

SCHOOL FOR GARDENING

The School for Gardening is at present completely housed in the old residence, where the drafting rooms, lecture room, and offices of the instructing staff are located. During the last year a reading room has been installed, providing easy access to all the leading horticultural periodicals.

Mr. Alexander Lurie, formerly instructor of horticulture, University of Maine, has been placed in charge of the students. The course of instruction has been remodeled and augmented during the past year to conform to the advancing requirements of the profession, and "The Hortus Club," a student organization, has been started for the purpose of discussing various matters of horticultural interest, which are not considered in the regular courses. The morning work of the students has been arranged to embrace a complete practical training in all the departments of the Garden during the three years.

Mr. C. F. Giebel and Mr. N. S. Philippi completed the course in September and were awarded the Garden certificate. Mr. Giebel is employed by Chas. W. Fulgraff, landscape architect, as draftsman and outdoor foreman in landscape gardening work, and Mr. Philippi is in charge of the Arboretum at the University of Michigan. As the result of the competitive examination, Miss Margaret Corley, of St. Louis, and Mr. George Pedlow, of Indianapolis, were appointed to the vacant scholarships. Mr. Garland Ellis, of

Fort Worth, Texas, Miss Clara Fuhr, and Mrs. Walter Goodwin are enrolled in all or a part of the courses.

RESEARCH AND INSTRUCTION

In spite of the impossibility of securing some much-needed apparatus from abroad, the facilities for graduate work and instruction have been augmented in important ways. Among the larger pieces of apparatus, a commodious soil sterilizer, with a steam chamber measuring 8 × 3 feet, has been installed. This will prove advantageous both in the experimental mushroom work and in permitting pathological experiments on a larger scale. An improved form of turntable, electrically driven, has been designed for the special purpose of studying the relation of spray mixtures to the transpiration of plants. A special tank and other apparatus required in certain studies on narcotization and respiration of bulbs and fleshy plant organs has been constructed.

Instruction, Lectures, Etc. — Graduate instruction in botany, offered in connection with the Shaw School of Botany of Washington University, and conducted in the graduate laboratories of the Garden, has been given in accordance with the program announced, — all members of the staff participating who are at the same time members of the faculty of Washington University. Since the number of graduate students is restricted, and most of them remain two or more years in the work, an effective policy of alternating the important courses other than those in research has been inaugurated, whereby the time of all teachers concerned is conserved most advantageously. Certain undergraduate courses are also open to graduates, so it may be noted that the following, whether graduate or undergraduate, were offered in the Shaw School of Botany during 1915–16: general botany, biology (in coöperation with the department of zoölogy), pathology, histology, bacteriology, morphology and taxonomy of the spermatophytes, plant geography, advanced physiology, special chapters in fermentation, and seminar; also research in physiology, morphology, taxonomy, and applied mycology.

Lectures and addresses by members of the scientific and Garden staffs during 1916 include the following:

B. M. Duggar, January 3, before the St. Louis Academy of Science, "An Economic Fungus of Wide Distribution."

Hermann von Schrenk, January 5, before the Society of Federal Contractors, U. S. Treasury Department, "Timber Specifications."

B. M. Duggar, January 13, before the Missouri State Horticultural Society, "The Development of Color in Flowers and Fruits."

Hermann von Schrenk, January 18, before convention of American Wood Preservers' Association, Chicago, "Fungi Which Grow on Timber."

Hermann von Schrenk, January 20, before meeting of architects at Minneapolis, "Timber Conservation and Use."

Hermann von Schrenk, January 25, before Illinois Society of Architects, Chicago, "Timber Conservation and Use."

Hermann von Schrenk, January 27, before the architects of Detroit, "Timber Conservation and Use."

George T. Moore, January 29, before the Massachusetts Horticultural Society, at Boston, "The Missouri Botanical Garden."

W. W. Ohlweiler, February 17, before the American Wheel Association, at the American Annex, "The Missouri Botanical Garden."

A. R. Davis, March 20, before the St. Louis Academy of Science, "Enzyme Action in the Marine Algae."

George T. Moore, March 27, before the Kirkwood Monday Evening Club, "The Missouri Botanical Garden."

George H. Pring, April 6, before the Mothers' Circle of the Clifton Heights School, "The Mimicry of Orchids."

B. M. Duggar, April 11, before the St. Louis Garden Club, "Some Fundamental Facts of Plant Life."

Hermann von Schrenk, April 25, before the science section of the Wednesday Club, "Diseases of Trees."

Alexander Lurie, April 26, before the open meeting of the Graduate Seminar, "The Development of the Carnation."

W. W. Ohlweiler, May 2, before the Lindell Boulevard Improvement Association, "Flowering Plants for St. Louis."

John Noyes, May 9, before the Lindell Boulevard Improvement Association, "Boulevard Design."

Alexander Lurie, May 11, before the St. Louis Florist Club, "The Development of the Carnation."

B. M. Duggar, May 26, before the St. Louis Association of Science and Mathematics Teachers, at Harris Teachers' College, "Chance and Adjustment vs. Purpose in the Responses and Evolution of Living Things."

Hermann von Schrenk, May 31, before the National Lumber Manufacturers' Association, Chicago, "Fire Resistive Wood."

Hermann von Schrenk, June 7, before the architects and engineers of Indianapolis, "Timber Uses."

B. M. Duggar, July 17–23, before the Graduate School of the Massachusetts Agricultural College, Amherst, Massachusetts, "Cell Entity or Growth Organization," five lectures.

George H. Pring, September 26, before the members of the Clifton Heights Presbyterian Church, "Insects and Flowers."

John Noyes, October 14, before the St. Louis Art League, "The Current Exhibit of Landscape Gardening in the Garden Museum."

Hermann von Schrenk, October 16, before the convention of Employes of Purchasing and Store Departments, Santa Fe System, at Temple, Texas, "Timber Specifications."

Hermann von Schrenk, October 18, before the convention of American Railway Superintendents of Bridges and Buildings, at New Orleans, "On Defects of Timber and Preventive Methods."

Hermann von Schrenk, November 1, before the convention of South Cypress Manufacturers' Association, Jacksonville, Florida, "Fire-Resistive Methods in Wood Construction."

Alexander Lurie, November 11, before the Association of Collegiate Alumnae, "Winter Protection of Plants."

W. W. Ohlweiler, November 13, before the Parkview Improvement Association, "Garden Development About the Home."

Hermann von Schrenk, November 14, before the Purchasing Agents' Association, Chicago, "On Structural Timbers, Their Use and Disuse."

George T. Moore, November 15, before the General Assembly, Graham Memorial Chapel, Washington University, "On Being Scientific."

Alexander Lurie, November 22, before the Railroad Branch, Y. M. C. A., "Flowers for the Home."

B. M. Duggar, November 29, before the General Assembly, Graham Memorial Chapel, Washington University, "A Phase of Plant Industry: a Chapter in National Preparedness."

Alexander Lurie, December 6, before the Missouri State Horticultural Society, Kansas City, "Tree Surgery."

John Noyes, December 12, before the St. Louis Garden Club, "Distinctiveness in the Garden."

W. W. Ohlweiler, December 15, before the St. Louis College of Pharmacy, "What the Missouri Botanical Garden Offers to the Student of Pharmacy."

Hermann von Schrenk, December 19, before the Purchasing Agents' Association of St. Louis, "Timber Specifications and How to Use Them."

The privileges of the graduate lecture room were extended to the Association of Collegiate Alumnae, November 11 and December 14, and to the State Audubon Society, December 15.

Graduates and Fellows. — The position of research assistant, formerly held by Dr. A. R. Davis, was filled by the appointment of Mr. G. W. Freiberg, formerly Rufus J. Lackland fellow. Mr. Freiberg has continued his investigations of mosaic diseases of certain economic plants and has assisted in various researches of the department.

The following are the 1916 appointments to the Rufus J. Lackland fellowships:

W. W. Bonns, S.B., Massachusetts Institute of Technology, B.S.A., Cornell University (formerly assistant professor of pomology, University of California, Citrus Experiment Station, Riverside, California), reappointed second year; C. W. Dodge, A.B., Middlebury College (formerly teacher of elementary botany, Middlebury High School), reappointed second year; D. C. Neal, B.S., Mississippi Agricultural and Mechanical College (formerly assistant plant pathologist, West Virginia Agricultural Experiment Station); L. J. Pessin, B.S., University of Georgia (formerly student curator of botany, University of Georgia); H. Schmitz, B.S. and M.S., University of Washington (formerly laboratory assistant, University of Washington).

Other appointments were as follows:

S. M. Zeller, special research assistant Yellow Pine Association, B.S., Greenville College, A.B. and A.M., University of Washington (formerly instructor in botany, University of Washington), reappointed third year; W. S. Reeves, B.S., Pomona College, scientific assistant to the Director, reappointed second year.

Graduate students holding positions in Washington University are the following:

H. M. Jennison, B.Sc., Massachusetts Agricultural College, M.A., Wabash College (assistant professor of botany and bacteriology, Montana State College, on leave of absence), assistant in botany, reappointed second year; J. W. Severy, A.B., Oberlin College, teaching fellow in the Henry Shaw School of Botany, reappointed second year.

Others registered for graduate work or pursuing researches in the graduate laboratory during the calendar year, for the most part registered for advanced degrees in Washington University or elsewhere, are A. R. Davis, Ph.D. (formerly research assistant); I. C. Hoffman, B.S. (Industrial

Fellow, Purdue University); R. A. Studhalter, A.B., and H. C. Young, B.S. and M.S. (formerly Rufus J. Lackland fellows); Ruth Beattie, A.B., University of Missouri; Lucy D. Foote, A.B., Clark College; Clara B. Hill, A.B., Vassar College; Alice Pickel, A.B., Washington University; J. Mathilde Rollman, A.B. and B.S., University of Missouri; A. Lurie, B.S., Cornell University (formerly assistant horticulturist, University of Maine).

Graduates formerly connected with the laboratory and terminating their connection during the calendar year have received appointments as follows: A. R. Davis (formerly research assistant), appointed assistant professor of botany, University of Nebraska; R. A. Studhalter (formerly Rufus J. Lackland fellow), appointed assistant pathologist, Montana Agricultural Experiment Station; H. C. Young (formerly Rufus J. Lackland fellow), appointed instructor in botany, Michigan Agricultural College; Ruth Beattie, appointed instructor in botany, Wellesley College.

Work in the graduate laboratory was continued during the summer by G. W. Freiberg, S. M. Zeller, W. W. Bonns, and Ruth Beattie. R. A. Studhalter assisted in the eradication of the citrus canker in Texas, Texas State Board of Agriculture, and W. S. Reeves pursued graduate work at the Marine Biological Laboratory, Woods Hole, Massachusetts.

At the commencement, June 8, the M.A. degree in the Henry Shaw School of Botany, Washington University, was awarded D. C. Neal (thesis, "A consideration of certain facts in the parasitism of Botrytis cinerea and Glomerella spp.").

From the preceding paragraphs it will be seen that the number of graduate students is considerable, and, for the present space arrangements, it is obvious to us that a maximum has been reached. For the academic year of 1916–17 there are registered fourteen students, of whom five are regular research fellows, five hold positions as instructors and assistants in Washington University and in the Missouri Botanical Garden, one is a special research fellow, one an industrial fellow from Purdue University, and two are without positions in affiliated institutions. The majority of these students require considerable space, not only in the graduate laboratory, but also in the experimental greenhouse, and the number has taxed the facilities at hand.

Work in Progress. — Diverse projects are under investigation by various members of the staff, and these, for the most part, represent work continued during a period of years, and adequately presented through special articles and also abstracts of scientific contributions. There may be given here, however, indications respecting the nature of the thesis problems under investigation by assistants, fellows, and other graduate students.

G. W. Freiberg. An investigation of the physiological-chemical relations of the mosaic diseases of tobacco, cucumber, and other plants, with special reference to the nature of the disease and the tissue changes induced by it.

S. M. Zeller. Studies dealing with the problem of conditions determining durability in wood, with special reference to the relation of resin content and density to fungous attack; likewise an investigation of the enzyme activities of certain wood-destroying fungi, and the correlation in timber between strength and resistance to fungous attack; and an investigation of ferrous chloride as a possible preservative of timber.

H. M. Jennison. Comparative studies of a number of strains of bacteria inducing black leg of potato.

W. W. Bonns. Studies on the effect of narcotization on the enzyme activities and respiration of such resting organs as potatoes, bulbs, seeds, etc.

W. S. Reeves. Investigation of the effects upon certain plants of over-feeding with, or deficiency in, certain mineral nutrients, with a view to the discovery of diagnostic indications for any particular effect.

J. W. Severy. The relation of temperature and humidity in the infection of plants with certain parasitic fungi.

D. C. Neal. Investigation of some phases of parasitism in the anthracnose of cotton and other anthracnoses; also certain rots of fruits and the conditions influencing their prevalence.

L. J. Pessin. The rôle of chemotropism in the infection of certain hosts by parasitic fungi.

H. Schmitz. The activity of bacteria in relation to cellulose fermentation and, in particular, to the decay of timber; also a comparative study of the conjoint action of different organisms in decay.

I. C. Hoffman. The effect of spraying on the set of fruit in cucumbers.

A. Lurie. A morphological study of the changes involved in the differentiation of chromoplasts.

Lucy D. Foote. A comparative histological study of certain representatives of the Ranunculaceae.

Alice Pickel. A systematic study of the genus Loeselia (a member of the Phlox family, Polemoniaceae).

Publications and Papers.—In the list below are included titles of all papers published during the year as a result of investigations and observations made in the laboratories, herbarium, and Garden, also papers based upon earlier work published during the year by members of the staff and graduate students.

Bonns, W. W. "Experiments with Stocks for Citrus." Cal. Agr. Exp. Sta. Bull. 267, 1916.

Burt, E. A. "The Thelephoraceae of North America. VI." Ann. Mo. Bot. Gard., 1916.

Burt, E. A. *Ibid.* VII. Ann. Mo. Bot. Gard., 1916.

Burt, E. A. "Pistillaria (subg. Pistillina) Thaxteri, Burt n. sp." Ann. Mo. Bot. Gard., 1916.

Bush, B. F. "The Missouri Agrimonies." Ann. Mo. Bot. Gard., 1916.

Davis, A. R. "A Note on the Adaptability of the Folin Micro-Kjeldahl Apparatus for Plant Work." Ann. Mo. Bot. Gard., 1916.

Duggar, B. M. "Rhizoctonia Solani in Relation to the 'Mopopilz' and the 'Vermehrungspilz.'" Ann. Mo. Bot. Gard., 1916.

Duggar, B. M. "The Texas Root Rot Fungus and Its Conidial Stage." Ann. Mo. Bot. Gard., 1916.

Duggar, B. M. "Botany." American Year Book, 1916.

Duggar, B. M., and Davis, A. R. "Studies in the Physiology of the Fungi. I. Nitrogen Fixation." Ann. Mo. Bot. Gard., 1916.

Emig, W. H. "The Occurrence in Nature of Certain Yeast-like Fungi with Reference to Their Possible Pathogenicity in the Higher Animals." Ann. Mo. Bot. Gard., 1916.

Gilman, J. C. "Cabbage Yellows and the Relations of Temperature to Its Occurrence." Ann. Mo. Bot. Gard., 1916.

Greenman, J. M. "Monograph of the North and Central American Species of the Genus Senecio—Part II." Ann. Mo. Bot. Gard., 1916.

Greenman, J. M. "A New Senecio from Jamaica." Ann. Mo. Bot. Gard., 1916.

Greenman, J. M. "Taxonomic Notes." Bot. Gaz., 1916.

Moore, G. T. "The Missouri Botanical Garden." Mass. Hort. Soc. Trans., 1916.

Overholts, L. O. "New or Interesting Species of Gill Fungi from Missouri." Ann. Mo. Bot. Gard., 1916.

Palmer, E. J. "Catalogue of the Plants of Jasper County, Missouri." Ann. Mo. Bot. Gard., 1916.

Schmitz, H. "Preliminary Note on the Occurrence of Peridermium balsameum in Washington." Phytopathology, 1916.

Schmitz, H. "Some Observations on Witches Brooms of Cherries." Plant World, 1916.

von Schrenk, Hermann. "Creosote for Wood Block Paving." Engineering News, 1916. *Ibid.* Proc. Am. Soc. for Municipal Improvements, 1915.

Zeller, S. M. "Studies in the Physiology of the Fungi. II. Lenzites saepiaria Fries, with Special Reference to Enzyme Activity." Ann. Mo. Bot. Gard., 1916.

The investigations completed during the year by members of the Garden staff have been published for the most part in volume 3 of the Annals, and in the following paragraphs there are given briefly some indications regarding the significance and trend of these studies.

Burt, E. A. (Ann. Mo. Bot. Gard. **3**:203–241, 319–343), has continued this important monograph of the Thelephoraceae of North America in successive numbers of the Annals. In the first paper the genus Hypochnus is treated. This has been separated from the more closely related genera, Corticium and Peniophora, by two characteristics: first, the possession of echinulate spores, and second, in the production, usually, of colored spores. From other related forms the additional characteristic of a hypochnoid or loose structure is also of service. For the first time this generic name is made the basis of a natural group, and here all North American species are assembled and described. Thirty-one species are discussed, of which thirteen are new species and twelve new combinations. These figures indicate strikingly the service which has been done in working over this genus. In the second paper there is given an account of Septobasidium which, while not truly a member of the Thelephoraceae, is included in this series of papers, since the form resemblance of these fungi to members of the family mentioned invariably brings the genus to the attention of mycologists interested in the Thelephoraceae. The genus is confined to tropical, or at least southern, localities, although a few northern stations are known. Its occurrence on living branches and its association with scale insects suggest an entomogenous habit. Seventeen species are discussed, ten being new and one a new combination. Previous work upon this genus has been done largely in France.

Burt, E. A. (Ann. Mo. Bot. Gard. **3**:403–406), in this paper discussed a new species of the club-shaped toadstool, this species being characterized by very simple structure and minute size; it is only one-tenth the size of the smallest toadstool known heretofore.

Bush, B. F. (Ann. Mo. Bot. Gard. **3**:309–318), has presented a key to the Missouri species of the genus Agrimonia —followed by a list with synonymy, citations, and localities for the forms which have been collected, the Garden herbarium being rich in such collections.

Davis, A. R. (Ann. Mo. Bot. Gard. 3:407–412), has contributed a note of interest regarding chemical technique. In plant pathological and physiological work the nitrogen content of very small organs or structures should frequently be known, and this paper is an indication of the adaptability of Folin's "micro" method of nitrogen determination to the problems in these phases of botany.

Duggar, B. M. (Ann. Mo. Bot. Gard. 3:1–10), in a previous volume, discussed the economic importance and biological life histories of the root-destroying fungi of the genus Rhizoctonia. In the present paper it is indicated that the common American species is the same fungus so widely distributed in Europe under the name of "potting-bench fungus." In Java and the East Indies the fungus, known as the "Mopopilz," is of much economic significance in the destruction of seedlings of the Cinchona and of other plants.

Duggar, B. M. (Ann. Mo. Bot. Gard. 3:11–24), has studied the Texas root rot fungus, which is one of the most disastrous cotton diseases in Texas and the southwest. New observations have been made upon the disease and upon its various host plants. In addition a conidial stage has been discovered and described, the significance of which, in the distribution of the disease, may be an important consideration.

Duggar, B. M., and A. R. Davis (Ann. Mo. Bot. Gard. 3:413–437) have drawn attention to the fact that all problems relating to fixation of nitrogen in the soil by microorganisms are of special agricultural interest as well as of fundamental importance. The results of this paper suggest that the representatives of the common moulds and other fungi are not important in the fixation of nitrogen, but a fungus parasitic upon the sugar beet, *Phoma Betae,* is found to have this capacity. The first fact controverts much European evidence and the last mentioned confirmed such previous studies.

Emig, W. H. (Ann. Mo. Bot. Gard. 3:243–307), has contributed a study on the occurrence of wild yeasts and other related fungi, in which is brought together an account of all the fungi which have been described as pathogenic or probably pathogenic to man and the higher animals. The comprehensive summary made will also make an important point of departure for subsequent work.

Gilman, J. C. (Ann. Mo. Bot. Gard. 3:25-84), has made an extensive study of the cabbage yellows, a disease which has proved an important limiting factor in the cultivation of cabbage, especially in Wisconsin. In this study the pathogenicity of the fungus *Fusarium conglutinans* as the causal organism is established, and the effect of temperature on the inception and prevalence of the disease is emphasized.

Greenman, J. M. (Ann. Mo. Bot. Gard. **3**:201–202), has described *Senecio Hollickii*, a species of Hawaiian origin, reported by Britton from Jamaica. New material enabled the author to separate it satisfactorily from *S. Swartzii*, with which he had formerly merged it.

Overholts, L. O. (Ann. Mo. Bot. Gard. **3**:195–200), has described four new species and one new variety of gill-bearing fungi, all being members of the fleshy fungi collected in the vicinity of St. Louis within the last few years.

Palmer, E. J. (Ann. Mo. Bot. Gard. **3**:345–401), has prepared a catalogue of the plants of Jasper County, Missouri, based upon collections made from 1901 to 1913. In all cases specimens have been deposited in the herbarium of the Garden, and as far as possible duplicates have been distributed to other herbaria. The list is an extensive one for this region, a "meeting ground" for various floras, but it is not regarded as a complete enumeration of the flora.

Zeller, S. M. (Ann. Mo. Bot. Gard. **3**:439–512), has completed a phase of his investigation on the activities of fungi inducing decay in structural timber, and the article mentioned considers particularly the physiological relations and digestive capacities of the fungus *Lenzites saepiaria.* Much new evidence is given in reference to the enzymes of such organisms, and especially interesting are the indications showing the relative activity of mycelium and sporophore in the contribution of enzymes. This more fundamental paper is preliminary to a more practical investigation of durability in wood.

HERBARIUM

Substantial progress has been made in the herbarium during the year. Important new material has been acquired, and a beginning has been made towards the replacement of the old wooden cabinet cases on the third floor with modern, fireproof, steel cases to conform with those already in use on the second floor; and one room has already been completely equipped with the new cases which at present are adequate to accommodate the ferns and the immediately allied groups. The appointment of Mr. J. C. Th. Uphof to the herbarium staff has facilitated the work of identification and distribution.

New Accessions. — Nearly 200 accessions have been received during the year. Some of the larger and more noteworthy of these are as follows: from Oakes Ames, 186 orchids of the Philippine Islands; Arnold Arboretum, 1,808 plants of Alaska, China, and Japan; E. Bartholomew, 200 "Fungi Columbiani" and 200 "North American Uredinales"; Bernice Pauahi Bishop Museum, 812 plants of the Hawaiian Islands; Dr. R. P. Burke, 186 fungi of Alabama; B. F. Bush, 3,593 plants, including his private moss herbarium; Carnegie Museum of Pittsburgh, 84 mosses of Pennsylvania and Ontario; F. C. Clements, 350 plants of California; F. S. Collins, 100 "Phycotheca Boreali-Americana"; D. L. Crawford, 214 plants of California; Rev. John Davis, 720 plants of Missouri; Th. Oswald Weigel, 200 plants of Hungary; C. W. Dodge, ferns of Vermont; J. A. Drushel, 335 plants of the United States; B. M. Duggar, fungi mainly from Colorado; W. H. Emig, 727 plants of Oklahoma and Missouri; W. G. Farlow, fungi from New England and Venezuela; G. W. Freiberg, 675 plants of Washington; J. W. Grant, 200 plants of Washington; Miss Caroline Haynes, Hepaticae mainly from New York; A. A. Heller, 400 plants of California; H. D. House, fungi of New York; E. L. Johnston, 181 plants of Colorado; Pedro Jörgensen, 429 plants of Argentina; Prof. C. H. Kauffmann, fungi from various localities; J. Macoun, 99 fungi from Canada; Miss Marion E. Moodie, 146 plants of Alberta; New York Botanical Garden, 1,358 plants from the West Indies; W. W. Ohlweiler, private herbarium of about 600 plants, largely from Connecticut; Dr. L. O. Overholts, fungi from various localities; E. J. Palmer, upwards of 8,000 plants from Arkansas, Louisiana, Oklahoma, and Texas; S. B. Parish, 87 plants of California; F. C. Seymour, 179 plants of Massachusetts; P. C. Standley, 315 plants of Florida; G. W. Stevens, 340 plants of Oklahoma; Dr. J. A. Stevens, fungi from Porto Rico; H. Sudre, 100 European plants; United States Department of Agriculture, Bureau of Plant Industry, 222 plants of the United States and China; United States National Museum, 186 plants from various localities; University of California, 451 plants of California; University of Texas, 353 plants of Texas; John Weldon & Co., 420 fungi; C. A. Wenzel, 1,375 plants of the Philippine Islands. A complete list of the accessions received during each month of the year has been recorded in the successive issues of the BULLETIN.

Mounting and Distribution. — The mounting of herbarium specimens has been vigorously pushed forward throughout the year; and the greater part of the material received on new accessions has been mounted and inserted in the organized herbarium. In addition to this, several thousand specimens from the private herbaria of Mr. A. W. Chapman and of Mr. Geo. W. Letterman have been mounted and incorporated in the general collection.

Field Work. — The botanical survey of the southwest in coöperation with the Arnold Arboretum of Harvard University has continued throughout the past season except for the last two weeks of August; and the collector, Mr. Ernest J. Palmer, has visited numerous localities in Missouri, Arkansas, Louisiana, Oklahoma, and Texas. Collections were made both in spring and autumn on an itinerary beginning in March and embracing the following and several intermediate stations which were visited in the order named: Victoria, Austin, Refugio, Garrado, San Antonio, Pleasanton, Boerne, Kerrville, Bryan, Valley Junction, Jacksonville, Fulton, Columbus, Fort Lynn in Texas; Shreveport, Mooringsport, Natchitoches, Grand Ecore, and Creston in Louisiana; San Augustine, Beaumont, Port Arthur, Silsbee, Liberty, Houston, Bay City, Brazoria, Vanderbilt, San Antonio, Boerne, Sisterdale, Fredericksburg, Kerrville, Sabinal, Utopia, Leakey, Burnet, Marble Falls, Granite Mountain, Llano, Lampasas, Brownwood, Santa Anna, Ballinger, San Angelo, and Bronte in Texas; Mariette, Ardmore, Bokchito, Bennington, Hugo, Broken Bow, and Valliant in Oklahoma; Fulton, Arkadelphia, Malvern, Benton, and Cotter in Arkansas; and ending at Galena, Missouri, in August. The autumn collecting was begun in September at Cotter and Fulton, Arkansas, Shreveport, Louisiana, and continued in Texas at San Augustine, Beaumont, Liberty, Houston, Livingston, Larissa, Palestine, Bryan, Austin, Pleasanton, Boerne, Kerrville, Fredericksburg, Junction, Telegraph, Rocksprings, Uvalde, Del Rio, Devils River, Comstock, D'Hanis, Sutherland Springs, Temple, Brownwood, San Angelo, Bronte, Chillicothe, Medicine Mound, and Denison; thence into Oklahoma at Durant, Bennington, Bokchito, and finally ending the season in November at Muskogee.

More than 10,000 excellent specimens of exceptionally interesting material were obtained. A considerable proportion of these were secured in the Edwards plateau region of Texas. These collections greatly augment the Garden's representation of the flora of the southwest.

Distribution of Duplicates. — A distribution of over 10,000 duplicate herbarium specimens has been made to several American institutions on the basis of exchange, and in return therefor a number of valuable series of *exsiccata* have been received. On account of the uncertainty in delivery of mail and express in European countries, no material has been sent to foreign institutions.

Use of Herbarium by Outside Botanists. — The number of visiting botanists making use of the herbarium is constantly increasing; and several loans of certain groups of plants have been made to institutions in different parts of the country in connection with monographic studies of specialists. In general such loans have proved of marked mutual advantage.

Statistical Summary: (For the year ending December 31, 1916).

Number of specimens acquired on new accessions:		
By purchase	10,282	
By gift	4,169	
By exchange	4,418	
By field work	8,800	
Total	27,669 valued at	$2,766 90
Number of specimens mounted and incorporated:		
From Chapman Herbarium	3,583	
From Letterman Herbarium	1,229	
From all other sources	16,926	
Total	21,738 valued at	$3,260 70
Number of specimens discarded from the herbarium	43	
Number of specimens sent to correspondents on the basis of exchange	10,041	
Number of specimens in unorganized herbarium (estimated at)	56,000 valued at	$4,480 00
Number of specimens in organized herbarium	803,563 valued at	$120,534 45
Wood specimens, etc., supplementing the herbarium, valued at		280 00
Microscope slides, etc., valued at		410 00
Total valuation		$125,704 45

LIBRARY

Throughout the year a large part of the daily work has been devoted to checking up and entering publications as they have been received, sending them at once on the round of the laboratories, collating them for the binders, and finally indexing and distributing them on the shelves.

We have been able to purchase from abroad but few of the old books which are still lacking to complete sets. The closeness of the blockade against Germany and Austria has cut off almost completely the trade with the book markets of those countries, and the offerings from old libraries in other European countries have continued unimportant to us.

Reclassification of Books. — The books and pamphlets bearing on the fungi are arranged alphabetically under author, a simple arrangement which has proved very satisfactory for finding quickly any publication in this section provided the author is known, but it has been of no aid in showing all the resources at hand in any subject subdivision of mycology. In order that no work may be overlooked, a subject card index has been in course of preparation during the year, and approximately 2,700 cards have been prepared already. Such a subject index for the portions of our library in most constant use has been greatly needed. It requires for its preparation only a fraction of the labor by the library staff which a reclassification of the books would have involved, and no user of the library has been inconvenienced by the work in progress. At any time in the future when different ideas in mycology may prevail, these cards may be rearranged under a new set of subject guides to be of the utmost service again.

Publications. — The ANNALS OF THE MISSOURI BOTANICAL GARDEN is our principal exchange for publications of scientific institutions and societies. The current volume of 512 pages, 9 plates, and 84 text figures contains the results of botanical researches by individuals connected with the Garden. It is computed that the value per year of exchanges received for the ANNALS is about $1,500.00. Some exchanges are also received for the BULLETIN. Both the ANNALS and the BULLETIN are supplied to regular subscribers, and separates of the various articles in the ANNALS are for sale by the library. The cash receipts from subscriptions and separates for the year were $331.64.

Loans of Books. — Inter-library loans of many books which are needed by investigators in educational institutions have been available. The borrower makes application for the loan through the library of his home university, which is responsible for its return at the expiration of the term and the payment of transportation both ways. Loans totaling 118 books have been made to 25 libraries in all parts of the middle west, chiefly during the year.

Card Index to Mycological Exsiccati. — The old card index to the contents of the mycological exsiccati was cumbersome by giving one card to each specimen, and the matter for which one consulted the card was inconveniently written at the very bottom. During the present year the library staff has rewritten this index according to the better form in use in the Cryptogamic Herbarium of Harvard University, fewer cards being required and the important matter being brought to the top of the card. As a result the old index of 16,110 cards, one entry to each card, has been replaced by one of 11,786 cards, which bears all the entries of the former index and 3,950 entries additional for the specimens which had been diverted to the general herbarium. This index, fitted up with 314 guides, is now installed in a new steel cabinet placed near the case containing our 20,060 specimens of fungi in published exsiccati.

Subject Index. — Work on the subject index of titles of botanical articles published by scientific societies of the world is in active progress. Indexing the serial publications of Great Britain and Ireland was completed at the end of last year, and about half of such publications from Germany and Austria have been indexed this year. In all, 13,730 articles are now indexed in 76 publications. The cards furnish immediate reference to important and often little-known papers in every field of botanical activity and also give large numbers of observations and detailed notes on plants and plant phenomena. The members of the scientific staff coöperate in the classification to make the index of the greatest scientific value.

Statistical. — There have been 405 volumes, valued at $907.95, and 882 pamphlets, valued at $179.50, donated to the library, and 366 volumes, valued at $1,234.13, and 15 pamphlets, valued at $9.50, purchased. The library now contains 34,528 books and 44,997 pamphlets, a total of 79,525, valued at $119,313.63. There are also 326 manuscripts, valued at $1,603.25, 887,345 index cards, valued at $8,901.75, and 157 maps, valued at $256.60, making the total estimated value of the library and card catalogue $130,324.13. A total of 20,220 index cards have been added during this year, of which 10,215 were typewritten by Garden employees, and 10,005 purchased at a cost of $128.35. The number of books bound was 597, and 3 maps, valued at $2.50, were donated.

STATISTICAL INFORMATION FOR DECEMBER, 1916

GARDEN ATTENDANCE:	
Total number of visitors	11,993
PLANT ACCESSIONS:	
Plants and seeds donated	29
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	44
Total number of books and pamphlets donated	145
HERBARIUM ACCESSIONS:	
By Purchase —	
Arnold Arboretum—Plants of China and Japan, collected by E. H. Wilson	1,575
Pedro Jörgensen—Plants of Argentina	101
By Exchange —	
Pomona College, by D. L. Crawford—Plants of California	214
U. S. Department of Agriculture, by P. L. Ricker—Plants of the United States	135
By Gift —	
J. Dearness—*Merulius lachrymans* showing both pileate and resupinate habit, from London, Ontario	1
J. A. Drushel—Plants from different parts of the United States	16
A. A. Hansen—*Geranium sibiricum* from State College, Pennsylvania	1
C. H. Kauffman—Fungi from Kentucky and Tennessee	38
O. S. Ledman—Plants of California and seeds of *Chelone* sp. from North Carolina	3
H. von Schrenk—Fungi on chestnut leaves	3
R. Thaxter—*Septobasidium pseudopedicellatum* on orange twigs from Trinidad, B. W. I.	1
By Field Work —	
E. J. Palmer—Plants of Missouri, Arkansas, Louisiana, Oklahoma, and Texas (estimated at)	8,740
J. C. Th. Uphof—Cultivated plants	3
TOTAL	10,831

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,

GEORGE T. MOORE.

BENJAMIN MINGE DUGGAR, Physiologist, in charge of Graduate Laboratory	**EDWARD A. BURT,** Mycologist and Librarian.
HERMANN VON SCHRENK, Pathologist.	**J. C. TH. UPHOF,** Assistant Botanist.
JESSE M. GREENMAN, Curator of the Herbarium.	**GEORGE W. FREIBERG,** Research Assistant.

KATHERINE H. LEIGH,
Secretary to the Director.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

JOHN NOYES,
Landscape Designer.

ALEXANDER LURIE,
Horticulturist.

A. B. MCINTYRE, Outdoor Gardens.	**W. F. LANGAN,** Engineer.
J. J. COUGHLIN, Construction.	**G. H. PRING,** Conservatories.
P. FOERSTER, Farm and Stables.	**M. SCHILLER,** Floral Displays.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. V FEBRUARY, 1917 No. 2

MISSOVRI BOTANICAL GARDEN
1889

CONTENTS

Page
Window Boxes, a Type of Floral Decoration Applicable to Down-town Districts - - - - - - 27
Back-Yard Gardens - - - - - - - 33
Notes - - - - - - - - - - 45
Statistical Information - - - - - - - 47

ST. LOUIS, MO.
1917
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

BOARD OF TRUSTEES OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

Edward C. Eliot.	**Leonard Matthews.**
George C. Hitchcock.	**William H. H. Pettus.**
P. Chouteau Maffitt.	**Philip C. Scanlan.**
Edward Mallinckrodt.	**John F. Shepley.**

EX-OFFICIO MEMBERS

Edmund A. Engler,
President of The Academy of Science of St. Louis.

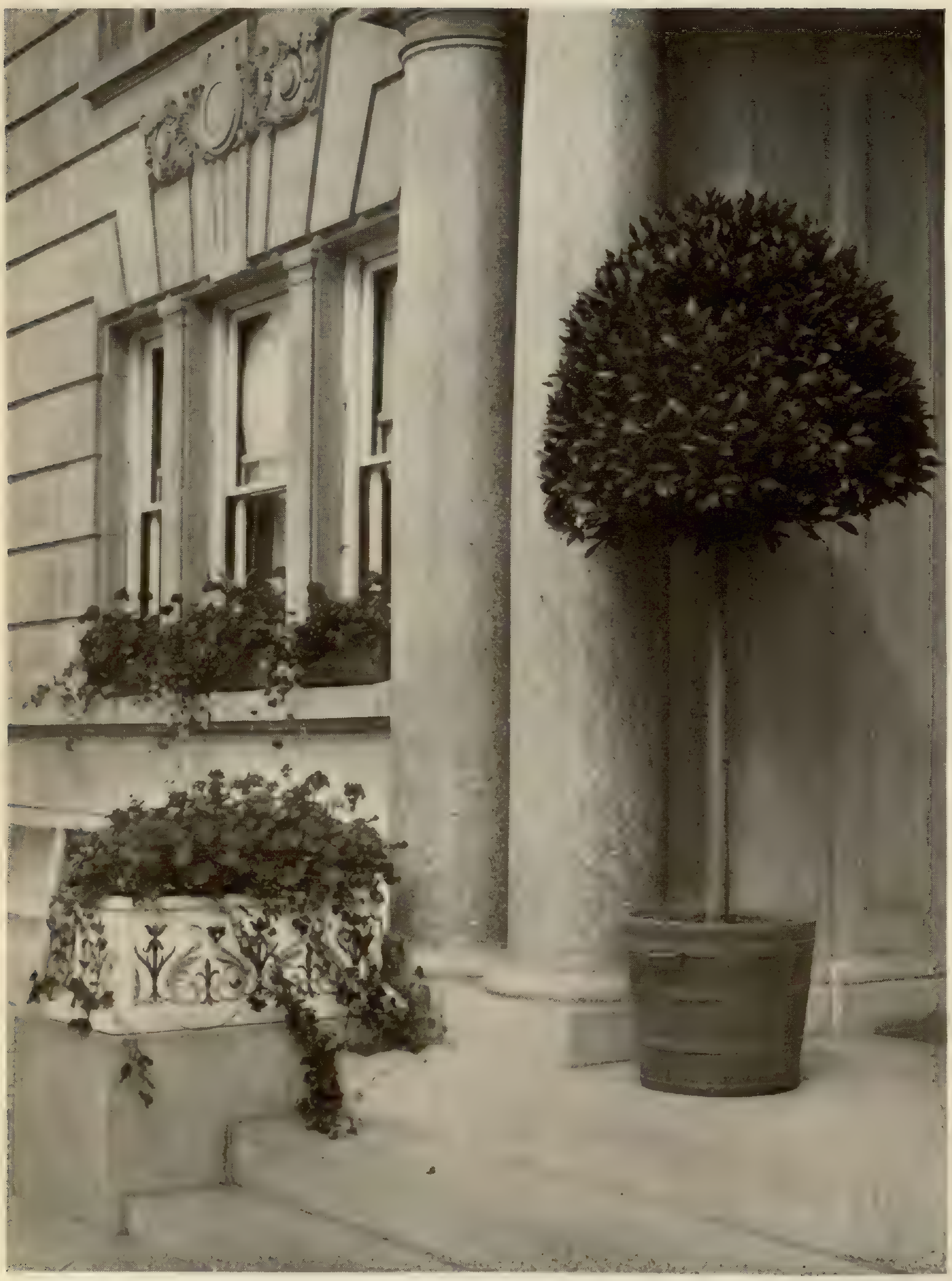
Henry W. Kiel,
Mayor of the City of St. Louis.

Frederic A. Hall,
Chancellor of Washington University.

Benjamin P. Stromberg,
President of the Board of Public Schools of St. Louis.

Daniel S. Tuttle,
Bishop of the Diocese of Missouri.

E. F. Finney, Assistant Secretary.



AN EFFECTIVE ARRANGEMENT FOR AN ENTRANCE—GERANIUMS AND ENGLISH IVY IN BOXES AND BAY TREES IN TUBS.

Missouri Botanical Garden Bulletin

Vol. V St. Louis, Mo., February, 1917 No. 2

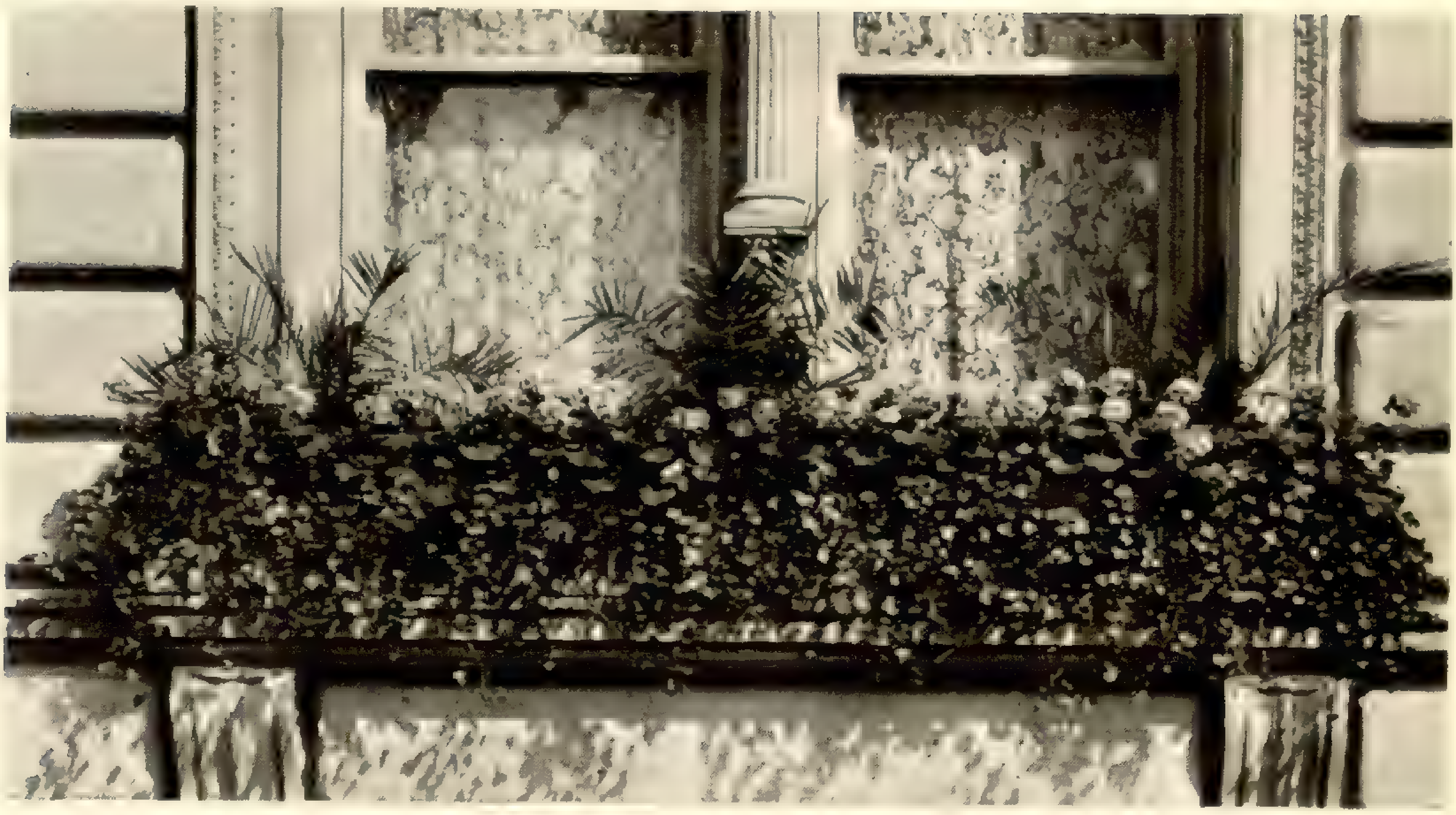
WINDOW BOXES, A TYPE OF FLORAL DECORATION APPLICABLE TO DOWN-TOWN DISTRICTS

In working toward the beautification of a city, the opportunity of making the business districts more attractive through floral features should not be neglected. Even public buildings of the noblest proportions and occupying suitable plats of ground are graced and rendered more beautiful by the profuse use of vines and shrubbery; and much greater is the need for touches of nature about the buildings in the crowded business section where the planting of trees and shrubs is an impossibility. Window boxes and vines break the monotony, soften the hard outlines of business structures, and refresh the eye, so that more and more the value of such floral features is appreciated and demanded.

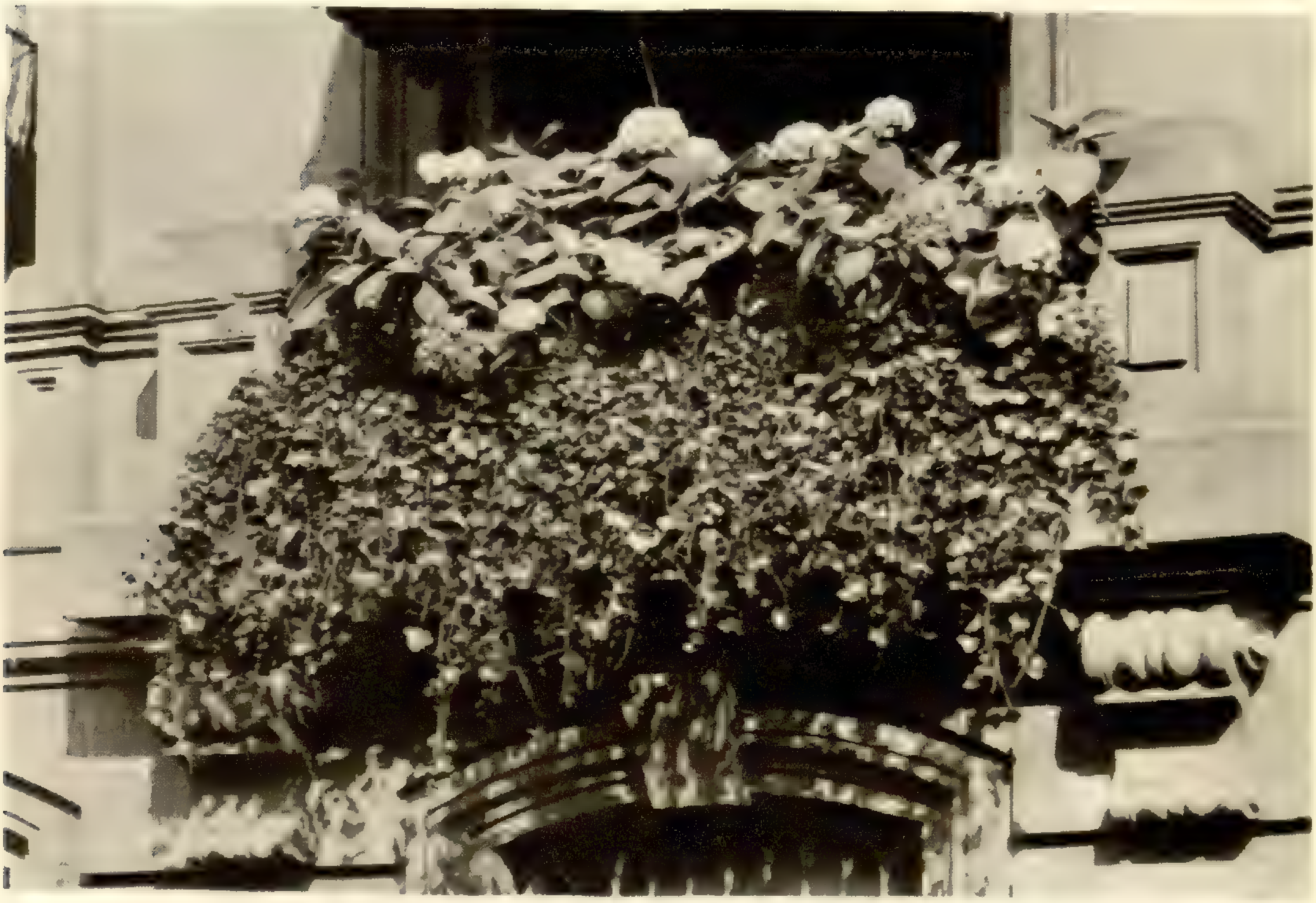
The use of window-boxes in the business districts is an extension of the spirit which encourages the floral decoration of the home and the public squares, and it is not an experiment in St. Louis. A much improved appearance was presented on some streets last season, due to the use of floral effects by firms whose interest was inspired or intensified both through the circulars prepared and distributed by the Business Men's League and through prizes for the best decoration — the latter being offered by the St. Louis Art League. It has taken more public spirit to coöperate in this movement than in the beautification of home grounds, because the good resulting in the former case is less tangible and the owner has perhaps far less opportunity than others to enjoy the effects. Nevertheless, it has been found, in cities where the movement has been carried out, that the utilization of plants in this way is an excellent advertisement, and that the effect upon those employed behind windows thus decorated is wholesome and conducive to better work. The experience of a large firm which has long used window boxes is reported as follows: "We have repeated this flower display every summer for a number of years and we find it not only a source of a great deal of pleasure to our customers and ourselves, but a practical means of advertising as well."

In arranging to employ window boxes, special attention should be given to the amount of sunshine they will receive, as upon this factor will depend the kinds of plants that may be used. Although all plants require light, some will grow even on the north side of buildings, especially if not also in the shadow of east and west walls. The arrangement of the boxes should be in harmony with the plan of the building, which means, of course, that the decorations should fit into the architectural scheme. This requires both that the locations of the boxes shall be suitable and that the composition shall be in scale with the building. On a large building it is often necessary, therefore, to group or mass the boxes, while on a small structure such an arrangement would be out of place. It is easy to overdo the use of certain conspicuous plants like those of trailing habit, and many boxes are often described as "weepy," due to the great profusion of hanging vines. The lines of most buildings are strong and upright, so that a certain sturdiness and uprightness of plants will often fit them better.

In filling the boxes, good taste must, in general, dictate in the matter of plants employed, at least as regards color, form, and size. These features, however, may well be left to the judgment of a competent florist, who in all cases should be given information regarding the exposure and the amount of light or shade which the boxes must endure. With respect to color it should be said that too great a variety should not be employed in any mixture, because this will not be as effective as a few well-chosen tones. Red, purple, or scarlet, suitable against light stone or stucco, should not be used against a red brick building. In the last-mentioned situation such contrasting colors as blues, yellows, and whites are usually better, and as much green as possible should be used to form the background and the framework for the flowers. Flowering plants should possess the qualities of rapid development, and profuseness and continuity of bloom. They will thrive only in sunny locations, with the exception of pansies, which are able to endure shade. In order to keep up a succession of bloom, the boxes may be filled in the spring with pansies and English daisies; these may be followed by flowering and foliage plants lasting throughout the summer, those in the following lists being recommended:



GERANIUMS, ENGLISH IVY AND DATE PALMS.



HYDRANGEAS AND ENGLISH IVY.

PLANTS FOR SUNNY SITUATIONS

Common Name	Botanical Name	Habit	Color
	FLOWERING		
Ageratum	*Ageratum mexicanum*	Upright	Blue and white
Candytuft	*Iberis umbellata*	Prostrate	White
Canna	*Canna* hybrids	Upright	Yellow, red
English daisy	*Bellis perennis*	Prostrate	White, pink
Geranium	*Pelargonium zonale*	Upright	Red, white, pink
Hibiscus	*Hibiscus coccineus*	Upright	Red
Heliotrope	*Heliotropium peruvianum*	Upright	Lavender
Lantana	*Lantana Camara*	Upright	Lilac, yellow, pink
Lobelia	*Lobelia Erinus*	Prostrate	Blue
Marigold	*Tagetes patula*	Upright	Orange, yellow
Nasturtium	*Tropaeolum majus*	Prostrate	Yellow, orange
Petunia	*Petunia hybrida*	Prostrate	White, pink, red
Pansy	*Viola tricolor*	Prostrate	Yellow, purple white
Phlox	*Phlox Drummondii*	Upright	White, pink, red
Pinks	*Dianthus sp.*	Upright	White, pink, red
Portulaca	*Portulaca grandiflora*	Upright	White, yellow, pink
Salvia	*Salvia splendens* var. "Zurich"	Upright	Red
Sweet alyssum	*Alyssum maritimum*	Prostrate	White
Verbena	*Verbena hybrida*	Upright	Lavender, pink
Vinca	*Vinca rosea*	Upright	Pink, white
	FOLIAGE		
Abutilon	*Abutilon hybridum*	Upright	Variegated
Coleus	*Coleus Blumei*	Upright	Variegated
Croton	*Codiaeum variegatum*	Upright	Variegated
Dracaena	*Dracaena indivisa*	Upright	Green
Dusty miller	*Centaurea candidissima*	Spreading	White
Eranthemum	*Eranthemum atropurpureum*	Upright	Purple
English ivy	*Hedera helix*	Trailing	Green
German ivy	*Senecio scandens*	Trailing	Green
Iresine	*Iresine Lindenii*	Upright	Red
Moneywort	*Lysimachia Nummularia*	Trailing	Green
Pandanus	*Pandanus Veitchii*	Upright	Variegated
Pyrethrum	*Pyrethrum roseum*	Upright	Yellow
Rubber plant	*Ficus elastica*	Upright	Green
Vinca	*Vinca major*	Trailing	Variegated
Wandering Jew	*Tradescantia zebrina*	Trailing	Variegated

PLANTS ENDURING SHADE

Common Name	Botanical Name	Habit	Color
	FLOWERING		
Pansy	*Viola tricolor*	Prostrate	Yellow, purple, white

Common Name	Botanical Name	Habit	Color
FOLIAGE			
Asparagus	*Asparagus Sprengeri*	Trailing	Green
Dracaena	*Dracaena indivisa*	Upright	Green
Dracaena	*Dracaena terminalis*	Upright	Red
English ivy	*Hedera helix*	Trailing	Green
German ivy	*Senecio scandens*	Trailing	Green
Sword fern	*Nephrolepis exaltata*	Upright	Green
Whitmani fern	*N. exaltata* var. *Whitmanii*	Upright	Green
Pandanus	*Pandanus Veitchii*	Upright	Variegated
Vinca	*Vinca major*	Trailing	Variegated
Wandering Jew	*Tradescantia zebrina*	Trailing	Variegated

The great range of available plants makes it impossible to indicate exactly what the arrangement and combinations in each case should be, but the following examples are suggested:

SUNNY LOCATION:

1. *Vinca major*—front.
   Petunia—filler.
   Ageratum—filler.
   Vinca rosea—points.

2. English ivy—front.
   Asparagus Sprengeri—front.
   Geranium—filler.
   Lantana—filler.
   Hibiscus—points.

3. Wandering Jew—front.
   Asparagus Sprengeri—front.
   Verbena—filler.
   Petunia—filler.
   Marigold—filler.
   Croton—filler.

SHADY LOCATION:

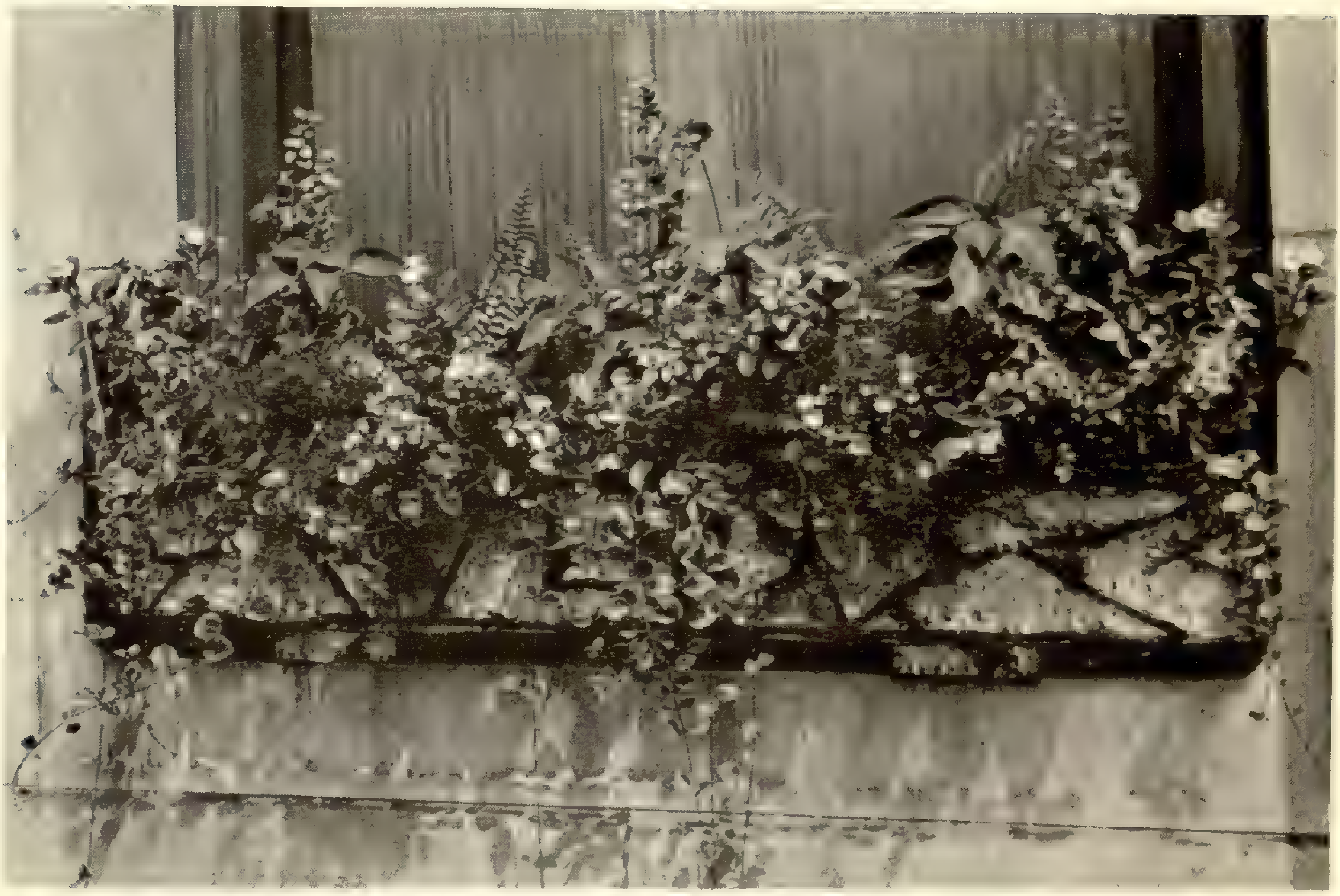
1. *Asparagus Sprengeri*—front.
   Dracaena terminalis—points.
   Boston fern—filler.

2. English ivy—front.
   Coleus—filler.
   Boston fern—filler.
   Pandanus Veitchii—points.

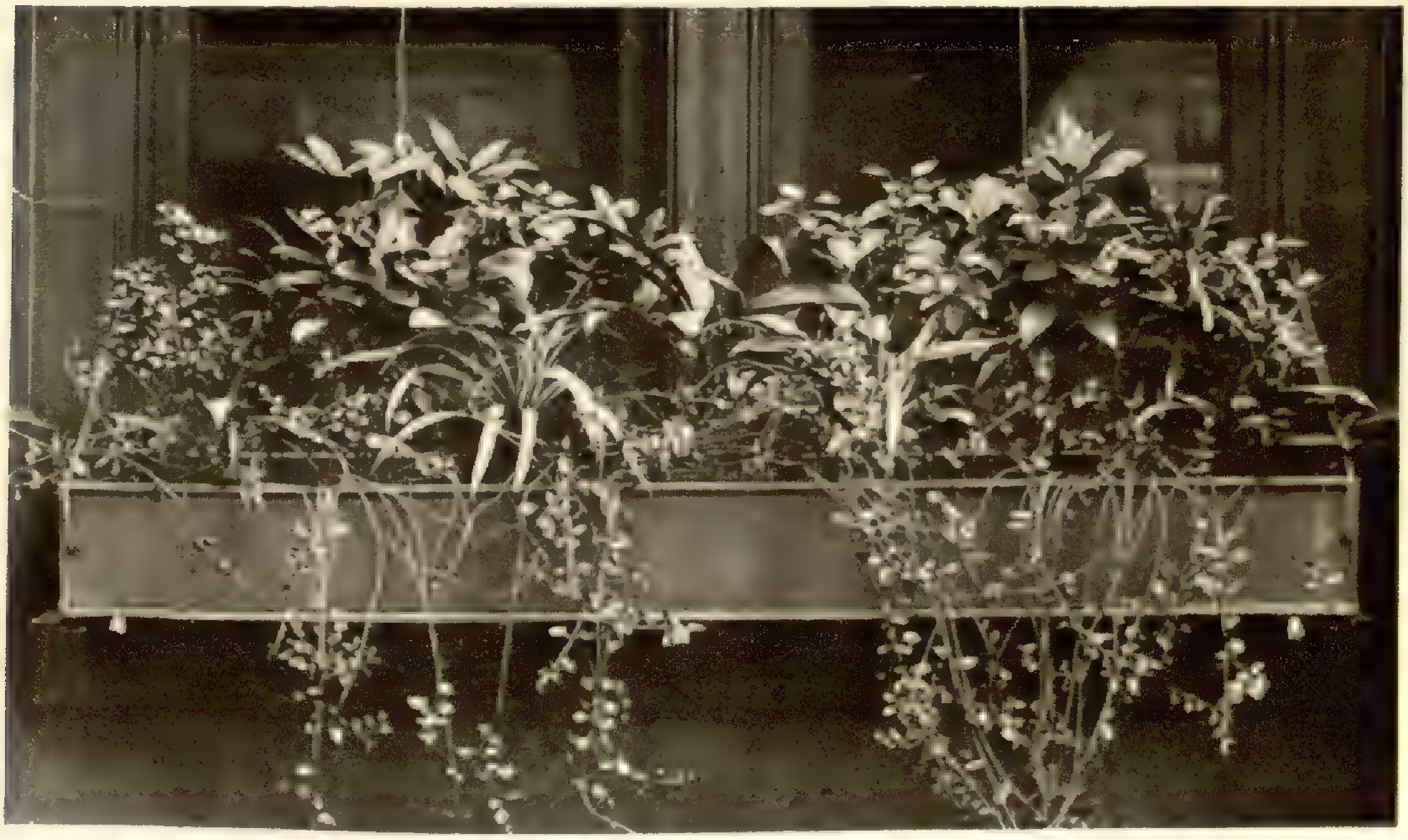
3. German ivy—front.
   Asparagus Sprengeri—front.
   Hibiscus—points.
   Whitmani fern—filler.
   Croton—filler.

The accompanying illustrations show the effect of some other desirable combinations.

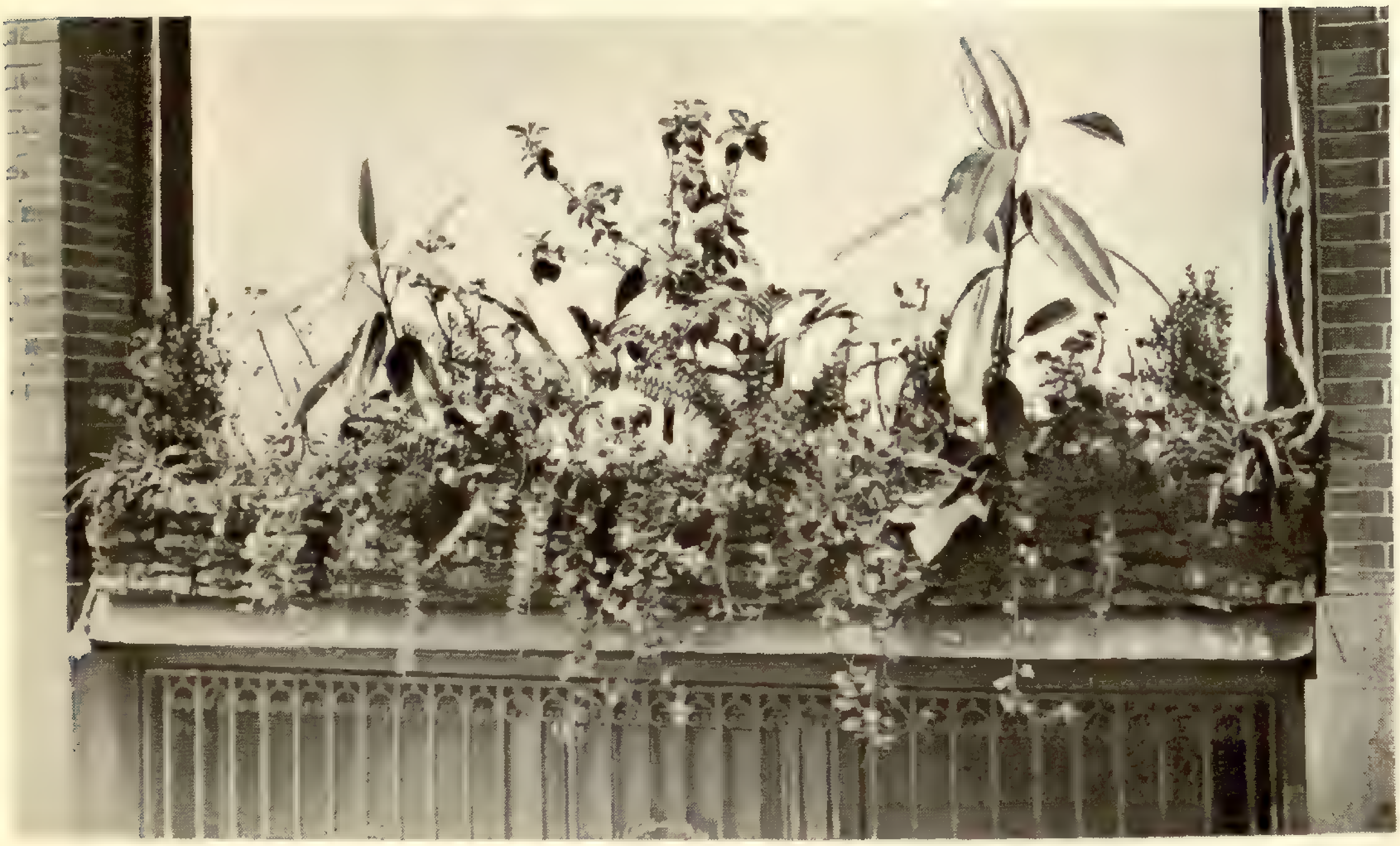
In the fall evergreens may be substituted, and with these early spring-flowering bulbs may be planted, tulips, daffodils, crocuses, snowdrops, etc., being used for this purpose. There are a great many evergreens adapted for winter effect. *Retinospora obtusa*, with its soft feathery foliage, remains green throughout the winter; the golden arbor-vitae (*Thuya occidentalis* var. *aurea*) with its bright yellow tinge, dwarf pine (*Pinus montana*), firs (*Abies*), Norway spruce (*Picea Abies*), Colorado blue spruce (*Picea pungens*), and the hemlock (*Tsuga canadensis*) produce very pleasing combinations. They may be arranged to produce a hedge-like appearance, or some points may be introduced either at the ends or in the center or both.



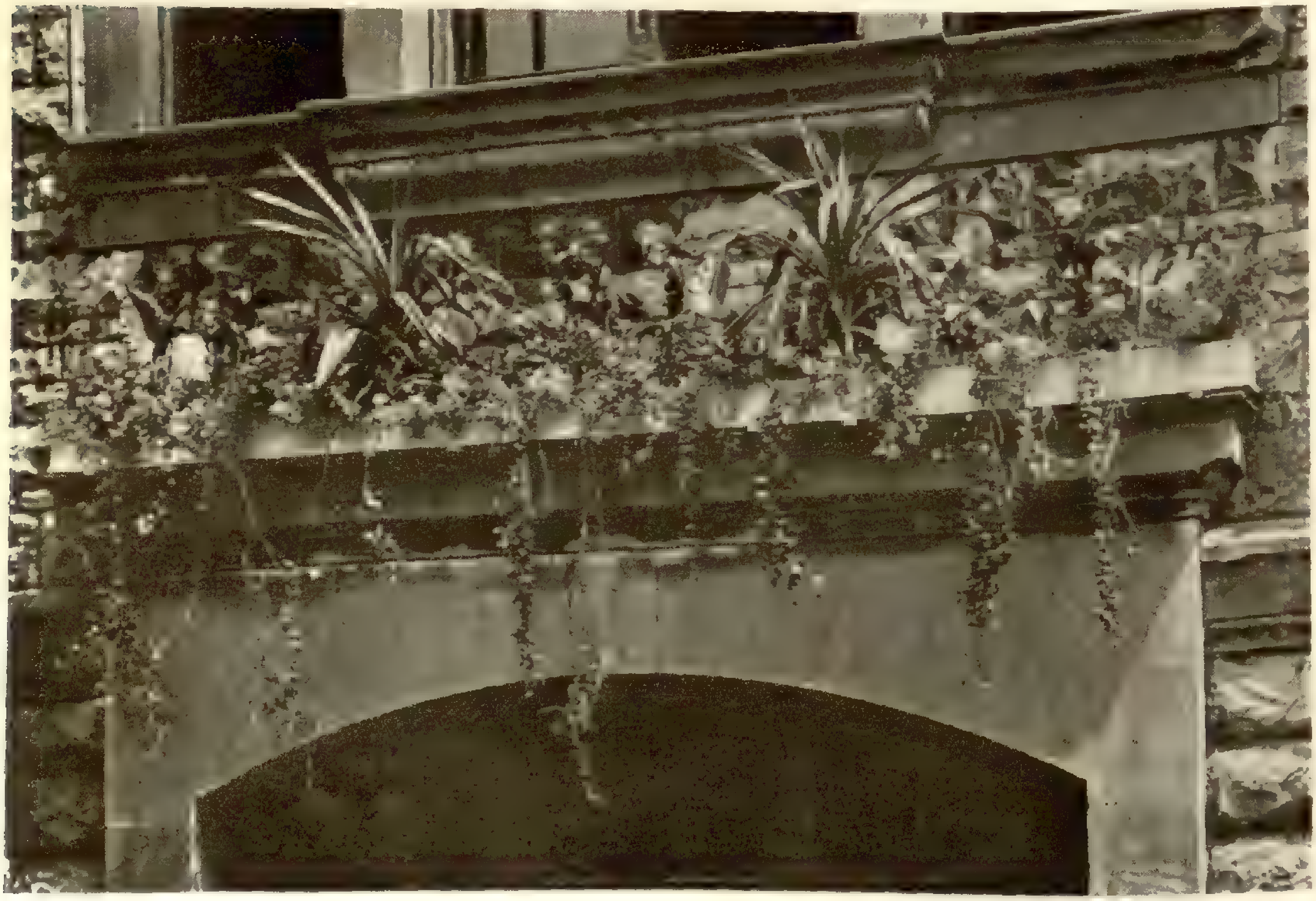
VINCA MAJOR, ASPARAGUS SPRENGERI, PETUNIA, VINCA ROSEA, COLEUS, BOSTON FERN.



HIBISCUS, CROTONS, VINCA MAJOR, DRACAENA TERMINALIS, PANDANUS VEITCHII.



BOXWOOD, RUBBER PLANT, HIBISCUS, GERANIUM, KENTIA PALM, VINCA MAJOR, ANTHERICUM, BOSTON FERN.



PANDANUS VEITCHII, CALADIUM, CANNA, ENGLISH IVY, VINCA MAJOR.

In selecting the type of box to be used, cost and durability must be taken into consideration. The wooden box still predominates, but it is gradually being replaced by more lasting and more ornamental receptacles. Terra-cotta, vitrified clay, and concrete are often employed in making boxes conforming to the general architecture of the building, and although the initial cost is considerable, they are practically indestructible and so in the end are the least expensive. The weight is the chief objection to boxes of this type, as they require strong, durable supports, eliminating any danger of collapse. However, there should be no difficulty in arranging satisfactory supports on any well-constructed building, many buildings, indeed, possessing ledges especially suited for such decoration. There are also a number of self-watering zinc and iron boxes which meet with favor where daily attention may prove an objectionable feature. It should be emphasized, however, that a wooden box constructed of such durable material as cypress or redwood, painted inside and out, and covered with the bark of cedar, hemlock, or birch, makes a very ornamental and satisfactory receptacle lasting several seasons.

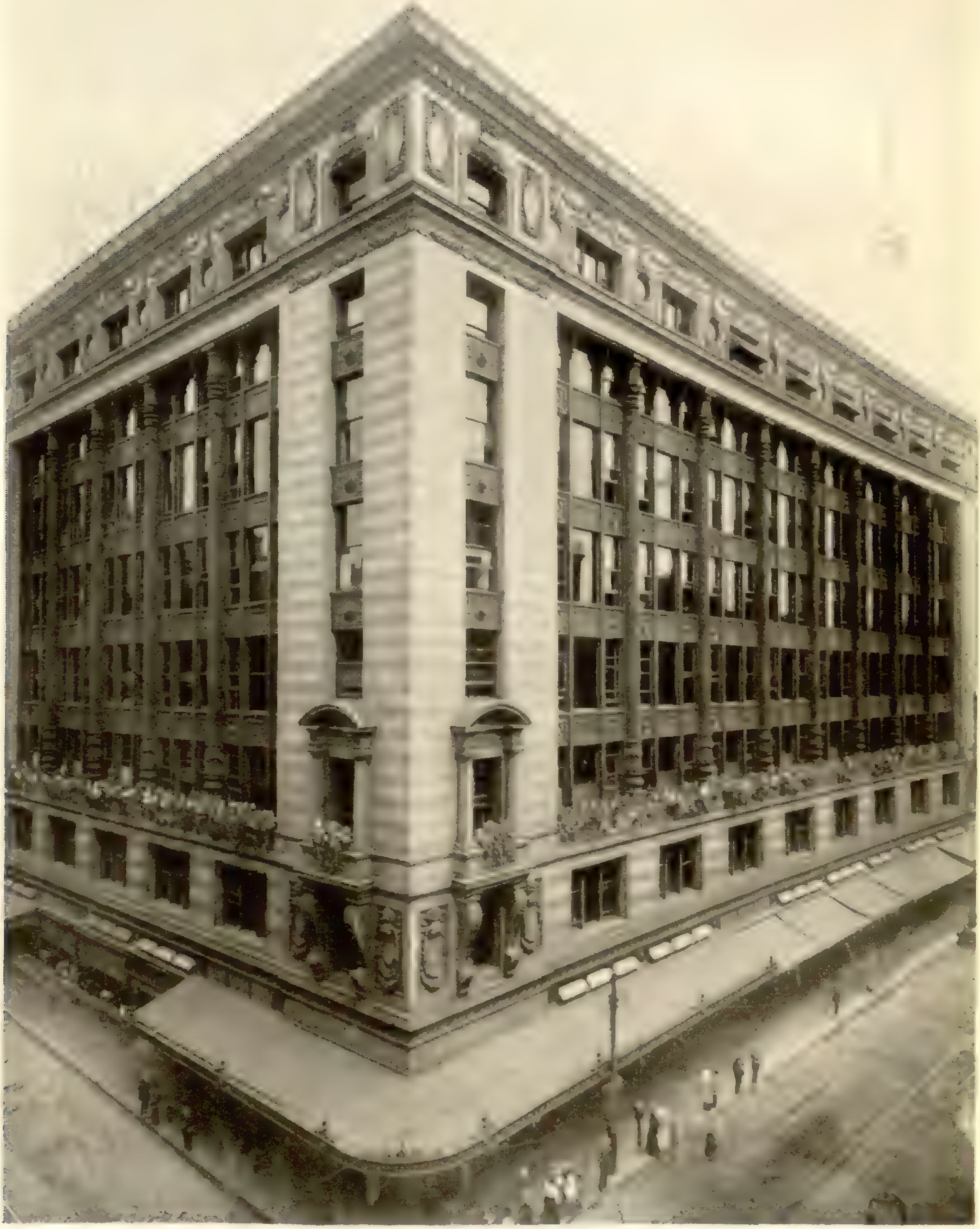
Window boxes vary a great deal in size. The length of the box is a minor feature providing it is in keeping with the size of the window, but the depth and the width are of considerable importance. No box should be less than 6 inches deep, and 8–10 inches would be still better, and the width should vary from 6 to 9 inches. When boxes are placed upon long sills it is best to have them in sections, otherwise they are unwieldy to handle and require strong supports. Where the sill is wide enough, screw-eyes in the window-frame and the box, connected by a wire, will be sufficient to hold the box in place. Usually the ledges are made sloping, so that it will be necessary to place strips of wood under the front part of the box to insure a level position. Boxes in upper-story windows should have galvanized iron drip-pans to catch the drip. These should be about 2 inches wider than the box, which should rest inside the pan upon cleats to allow for free escape of water.

Drainage should be thoroughly looked after. It is true that usually the outside boxes suffer more from lack of moisture than over-abundance of it; nevertheless, if no means is provided for getting rid of the surplus water, except through evaporation, the plants will suffer. It is difficult enough to grow plants satisfactorily under down-town conditions without imposing upon them any additional hardships. A number of half-inch holes should be made in the bottom of the box, and these partly covered with pieces of crock placed curved side up. This precaution is essential to prevent the soil from sifting through the holes and occasionally clogging them. As the plants in the box are of necessity crowded, the soil should be rich enough to produce a stocky, healthy growth, one part of well-rotted manure and four parts of fibrous loam being a good mixture. The box should be filled with soil to within one inch of the top to allow for watering. During the season it may be desirable to sprinkle the plants with liquid manure to replenish the food in the soil, but if this is not available, concentrated sheep manure or complete commercial fertilizers may be applied. Upon the watering, or the lack of it, very often depends the success or failure of the box. The frequency of watering can only be determined by actual practice, being dependent upon atmospheric conditions, soil, sunlight, wind, etc. However, it is always best to water as late in the day as convenient, after sunset preferably, during the summer months. Washing of the foliage is also essential to keep the leaves clear of dust, which clogs the air-pores to the detriment of the plants.

The chief insect enemies that may attack plants are the green aphis and the red spider. The former may be eradicated by spraying with a tobacco solution obtainable at any seed or flower store. Thorough syringing of the foliage on both sides with a forcible fine water spray will eliminate the red spider.

At the entrances to theaters, hotels, and similar institutions, appropriate street boxes filled with plants add an air of refinement and quality. In such localities hanging baskets may also be used to advantage, these being made of rustic wood work, terra-cotta, crockery, galvanized wire, etc. The plants used are similar to those of the window boxes, and the tall kinds are generally placed in the center and flowering and trailing ones along the sides. Still greater care must be given to the plants when baskets are used, as the space for soil is small and the exposed location is subject to the action of drying winds.

In this article the window box is the central feature of the discussion, but in a later bulletin it will be pointed out that in smaller towns where the buildings often stand farther apart there are opportunities for a more varied type of decoration, including a much freer use of vines, shrubbery, and other landscape possibilities. In some of the southern cities, for instance, a unique feature is utilized of placing specimen palms in tubs along the sidewalks and planting vines at their bases to cover the trunks. In other cities ornamental lamp posts are decorated with baskets or boxes of plants suspended



EFFECTIVE WINDOW BOXES IN DEPARTMENT STORE, BOSTON, MASS.

at the top or midway, thus relieving the monotony of the bare iron structures. Old and unsightly buildings, which the circumstances prevent from being removed, may be beautified and rendered inoffensive to the eye by the use of quick-growing vines planted at the corners.

BACK-YARD GARDENS

Since the first article in this number of the BULLETIN is devoted to a type of floral decoration which may be used in the beautification of the down-town districts, it has seemed appropriate to include, in the same number, suggestions applicable to that part of the premises in the residential sections most frequently receiving less attention, that is, the back yard.

Cleaning up is the first step in the movement for back-yard improvement. A trim lawn and a painted fence, where a fence is unavoidable, inconspicuous ash-pits, and clean walks make for attractiveness. This accomplished, the development of the garden is the next step.

A garden is possible in any space admitting sunlight, and of any size from the area of a window box up. Quite an effective garden can be developed in the typical back yard of approximately 30 by 60 feet. Larger spaces admit of greater possibilities, of course, perhaps more than one garden being practicable.

Probably there is no better way to bring out ideas on the development and possibilities of back-yard gardens than by a description of the plans of four such gardens to be laid out this spring in the new economic garden. These four gardens, each of which is about 29 by 60 feet, differ in design and in the types of planting material and should suggest other designs and arrangements to the garden enthusiast. There will be a combined flower and vegetable garden, a shrubbery and perennial garden, a rose garden, and a subtropical garden. All of these will be separated and enclosed by a hedge of California privet and each will have one large tree, in this case an apple. A small and inexpensive pool will be included in each, and an arch for flowering vines will mark what would be the gateway to the alley.

In the flower and vegetable garden the flowering plants are confined to the borders, and the vegetables to the interior square beds. A rectangular space is reserved in the center for a central pool, small lawn, and four dwarf fruit trees, and seats at either side mark the cross axis of the garden. Four additional dwarf fruits are placed near the corners of the garden for accent. The seed—both flower and vegetable—for planting this garden would cost about four or five dollars, while the dwarf trees and a proportionate share of the hedge would amount to about thirty dollars. With the continuous succession of crops the vegetable garden should yield for the table material having a retail value of from twenty to twenty-five dollars.

The shrubbery and perennial garden attempts more informality than the others, though this is difficult to attain with success in a space so small and so formal in outline. Once established, this garden would require much less maintenance, and would be much more permanent, than any of the others. The shrubs used are mainly low-growing types, and the few taller-growing ones could easily be kept under 8 feet in height by judicious pruning. The perennials will border and intermix with the shrubbery, the taller kinds in the background and the smaller ones at the border. As is desirable in this type of development, as much space as possible is devoted to open lawn. The pool is in the center again and seats are placed at either side. If fairly large shrubs and plants and a large apple tree are used, the cost of planting this garden, including a proportionate share of the hedge, would be about sixty dollars, hedge and apple tree being estimated at twenty dollars, the shrubs at fifteen, and the cost of perennials making up the remainder.

The rose garden differs materially from the others in design. The pool in this case is at the end, on the long axis of the garden, and there is a seat against the shrubbery in addition to those on either side. A large part of the space is devoted to lawn, and the roses are confined to the border, standard varieties being used for accent, as shown on the plan. Including the purchase of a large apple tree and a proportionate share of the hedge, ninety dollars would cover the cost of planting this garden. This is considerably more than the preceding, but the roses alone would cost in the neighborhood of seventy dollars.

Except for the hollies and junipers, the subtropical garden is devoted almost entirely to types of plants that are not indigenous to St. Louis and yet which thrive magnificently in our summer climate. Used with native shrubbery and perennials, this material usually produces the most incongruous and inharmonious effects, but when grouped with others of their kind, striking and beautiful results are possible. Again the plan is formal in design, with the pool in the center and seats on either side. The cost of the plants, trees, and hedge for this garden would be about one hundred dollars, holly and juniper trees alone costing probably in the neighborhood of seventy dollars.

There are very few practical requirements that would interfere with the making of similar gardens in the back yards of St. Louis. The ash-pit could be easily hidden by shrubbery or vines in most cases, and there would be space in all of the gardens for the drying of clothes, especially if the circular, removable type of clothes-pole were used. Hedges on the property line are possible almost everywhere, though an attractive fence covered with woody vines would be equally effective. Admitting the practicability and durability of the cement walk, it is believed that the more attractive walk of stepping-stones, flagging, or brick would in most cases suffice and probably be less expensive.

For the best results first settle on the best design you can think of. Even though the beauty of living plants may make a garden of poor design attractive at times, it is quite evident that only by a combination of healthy, vigorous plants, excellent maintenance, and good design, will the greatest success be attained. Avoid freakish and unusual plant forms; there is usually far more beauty in the plants of normal growth. Weeping mulberries, umbrella catalpas, and similar types are hardly adapted to the small lot, and are usually in place only in the formal garden of large scale when used much the same as the standard roses shown in the plan of the rose garden.

Though it is true that most plants should have sunny exposures, it has been proven in this city by actual experience that most of the hardy shrubs will thrive if planted on the north side, even at the base of the house. Strictly speaking, there is scarcely a part of the grounds of our typical house-lot that will not get the sun for a part of the day, at least, during the summer.

Many home-owners are afraid to attempt back-yard gardens because of the poor condition of the soil — the brickbats, stone, plaster, and tar paper inherited from the house contractor — but this obstacle is easily overcome. Replacing the soil with good loam would be best, but by no means absolutely necessary, and if the stones, bricks, etc., are removed from the bed in the fall, and manure, lime, and fertilizer spaded in, the soil will be in fair condition by spring. The constant spading, manuring, and proper fertilizing thereafter will gradually build up a good soil for garden purposes.

The whole question of the home and its grounds is one of the important problems of city planning, not yet as pressing as some others, but one which requires considerable study. The division of the city into zones and districts will gradually result in sections exclusively for residences. Building-line regulations are already well established, and the control of building heights will become more absolute and rigid. Street tree planting is governed in practically all of the large cities, the species of tree on each street and their spacing being decided by the city forestry department. The engineering features of the street are consistent and in good order; convenience, public safety, and sanitation demand that they be so.

All of these things tend toward harmony and order, and hence beauty, in the appearance of the street. The next step, that of determining the architectural character of the residence and the landscape treatment of its front yard, has not been generally taken up by cities of this country, but it is surely coming. Great attention has been paid to this question, with remarkable and beautiful results, by many European cities, especially Paris and some of the cities of Germany, and, too, by the so-called garden cities of Europe and this country. A street is in itself an architectural unit, and its side bounds are not the sidewalk lines, which are inconspicuous, but the front walls of the residences. Not until this entire space from building to building is treated consistently and with attention to the best principles of architectural and landscape design will our streets attain the beauty of which they are possible. Each residential street or subdivision should have a consulting architect to prescribe certain limits of design in the house, and a landscape architect to plan the landscape development from building line to building line.

In many of the new garden cities and residential developments the back yard or a portion of it is united with the other adjoining yards to form a park or playground for the use of the occupants of the entire block. This is a wonderful idea and one that is increasing in popularity and demand. Certainly, in crowded sections where back yards are of the minimum size, and where the enclosure approaches the interior courtyard in nature, this is the only possible solution. Such developments in the older, established sections of the larger type lot, however, could not be brought about except by considerable expense, and it is probable that the desire for them could not be awakened. It is likely that no matter what is done with the front yard, the back yard will generally remain a part of the home — in a sense an outdoor living-room. Unfortunately, too many fail to see the opportunities of this area, and are inclined to treat it as they would their basement, a place for storage of undesirable objects.

The September, October, and November, 1915, BULLETINS give a complete list of flowering trees, shrubs and perennials which thrive in St. Louis, and many of these might be substituted for those used in the back-yard gardens described herein. On the house, the fence, on trellis or arch there are many vines that might be used to good advantage, and a brief list of these follows:

ANNUAL VINES:

Balloon-vine—*Cardiospermum Halicacabum.*
Wild cucumber—*Echinocystis lobata.*
Hop-vine—*Humulus japonicus.*
Morning-glory—*Ipomoea purpurea.*
Moon-flower—*Ipomoea Bona-nox.*
Balsam pear—*Momordica Balsamina.*
Scarlet runner bean—*Phaseolus multiflorus.*

PERENNIAL VINES (Herbaceous):

Kudzu vine—*Pueraria Thunbergiana.*
Moon-flower—*Ipomoea pandurata.*
Everlasting pea—*Lathyrus latifolius.*

WOODY VINES:

Akebia—*Akebia quinata.*
Virginia creeper—*Ampelopsis quinquefolia.*
Dutchman's-pipe—*Aristolochia Sipho.*
Clematis—*Clematis paniculata.*
Bittersweet—*Celastrus scandens.*
Matrimony-vine—*Lycium chinense.*
Honeysuckle—*Lonicera japonica.*
Trumpet creeper—*Tecoma radicans.*
Grape—*Vitis rotundifolia.*
Wistaria—*Wistaria chinensis.*

VINES FOR BRICK AND STONE:

Boston ivy—*Ampelopsis Veitchii.*
English ivy—*Hedera Helix.*
Evonymus radicans.
Ampelopsis quinquefolia var. *Engelmanni.*

FLOWER AND VEGETABLE GARDEN

	Bed No.	Common Name	Botanical Name
Trees	1	Apple	*Pyrus Malus*
	2	Dwarf cherry	*Prunus Cerasus*
	3	Dwarf peach	*Prunus persica*
Vegetables	4	Tomato	*Lycopersicum esculentum*
	5	Beans	*Phaseolus vulgaris*
	6	Asparagus	*Asparagus officinalis*
	7	Mint	*Mentha piperita*
	8	Rhubarb	*Rheum Rhaponticum*
	9	Radish	*Raphanus sativus*
	10	Lettuce	*Lactuca sativa*
	11	Leek	*Allium Porrum*
	12	Spinach	*Spinacea oleracea*

FLOWER AND VEGETABLE GARDEN—Continued

	Bed No.	Common Name	Botanical Name
Vegetables	13	Parsley	*Carum Petroselinum*
	14	Swiss chard	*Beta vulgaris* var. *cicla*
	15	Cabbage	*Brassica oleracea*
	16	Turnip	*Brassica rapa*
	17	Parsnip	*Pastinaca sativa*
	18	Beets	*Beta vulgaris*
Annuals	19	Cosmos (mixed)	*Cosmos bipinnatus*
	20	Dahlia (mixed)	*Dahlia coccinea* var. *rosea*
	21	Sage	*Salvia farinacea*
	22	Floss flower (blue)	*Ageratum mexicanum*
	23	Zinnia	*Zinnia elegans*
	24	Tickseed (yellow)	*Coreopsis coronata*
	25	Verbena (mixed)	*Verbena hybrida*
	26	Petunia (mixed)	*Petunia hybrida*
	27	Bachelor's button	*Gomphrena globosa*
	28	Cockscomb	*Celosia plumosa*
	29	Corn-flower	*Centaurea Cyanus*
	30	China aster (white)	*Callistephus hortensis*
	31	Spider plant	*Cleome pungens*
	32	Marigold	*Tagetes erecta*
	33	Pansy (mixed)	*Viola tricolor*
	34	Shirley poppy	*Papaver Rhoeas*
	35	Cone-flower	*Rudbeckia bicolor* var. *superba*
	36	Sweet-William	*Dianthus barbatus*
	37	Wistaria	*Wistaria chinensis*

SHRUBBERY AND PERENNIAL GARDEN

	Bed No.	Common Name	Botanical Name
Trees	1	Apple	*Pyrus Malus*
Shrubs	2	Golden-bell	*Forsythia viridissima*
	3	Barberry	*Berberis Thunbergii*
	4	Spiraea	*Spiraea Thunbergii*
	5	Spiraea	*Spiraea Van Houttei*
	6	Globe-flower	*Kerria japonica*
	7	Deutzia	*Deutzia scabra*
	8	Deutzia	*Deutzia gracilis*
	9	Buddleia	*Buddleia variabilis*
	10	Hibiscus	*Hibiscus syriacus*
	11	Weigelia	*Diervilla* "Eva Rathke"
Perennials	12	Candytuft	*Iberis sempervirens*
	13	Peony (red)	*Paeonia albiflora*
	14	Oriental poppy	*Papaver orientale*
	15	Iris (blue)	*Iris germanica*
	16	Iris (blue)	*Iris Kaempferi*
	17	Alyssum	*Alyssum saxatile* var. *compactum*
	18	Canterbury bells	*Campanula carpatica*
	19	Milfoil	*Achillea Ptarmica* "The Pearl"
	20	Phlox (pink)	*Phlox paniculata*
	21	Phlox (red)	*Phlox paniculata*
	22	Phlox (white)	*Phlox paniculata*
	23	Tickseed	*Coreopsis lanceolata* var. *grandiflora*

	Bed No.	Common Name	Botanical Name
Perennials	24	Blanket flower	*Gaillardia grandiflora*
	25	Helenium	*Helenium autumnale*
	26	Pink	*Dianthus latifolius* var. *atrococcineus*
	27	Shasta daisy	*Chrysanthemum Leucanthemum*
	28	Hollyhock	*Althea rosea*
	29	Golden-glow	*Rudbeckia laciniata*
	30	Aster	*Aster novae-angliae*

ROSE GARDEN

Bed No.		Horticultural Name	Color
1	Apple	*Pyrus Malus*	
2	Holly	*Ilex opaca*	
3	H.T.* Rose	Antoine Rivoire	Pink or yellow
4	H.T. Rose	Duchess of Wellington	Yellow
5	H.T. Rose	Francis Scott Key	Red
6	H.T. Rose	Gruss an Teplitz	Red
7	H.T. Rose	Kaiserin Augusta Victoria	White
8	H.T. Rose	Killarney	Pink
9	H.T. Rose	Lady Ashtown	Pink
10	H.T. Rose	La France	Pink
11	H.T. Rose	Miss Cynthia Forde	Pink
12	H.T. Rose	Sunburst	Yellow
13	H.T. Rose	Lady Hillingdon	Yellow
14	H.T. Rose	White Killarney	White
15	H.T. Rose	Mrs. Andrew Carnegie	White
16	Rosa Rugosa		
17	Climbing Rose	Dorothy Perkins	Pink
18	Standard Wichuraiana Rose	Lady Gay	Pink

SUBTROPICAL GARDEN

Bed No.	Common Name	Botanical Name
1	Apple	*Pyrus Malus*
2	Juniper (2 ft.)	*Juniperus chinensis* var. *hibernica*
3	Holly (4 ft.)	*Ilex opaca*
4	Croton	*Codiaeum variegatum*
5	Castor-oil bean	*Ricinus zanzibariensis*
6	Elephant ears	*Colocasia esculenta*
7	Great reed	*Arundo Donax*
8	Zebra grass	*Eulalia japonica*
9	Fountain-grass	*Pennisetum japonicum*
10	Fire-bush	*Kochia Icaparia*
11	Geranium (white)	*Pelargonium zonale*
12	Geranium (red)	*Pelargonium zonale*
13	Geranium (red)	*Pelargonium zonale*
14	Geranium (pink)	*Pelargonium zonale*
15	Scarlet sage	*Salvia splendens*
16	Zinnia (mixed)	*Zinnia elegans*
17	Dahlia (mixed)	*Dahlia coccinea* var. *rosea*

---

* H.T.=hybrid tea.

SUBTROPICAL GARDEN—Continued

Bed No.	Common Name	Botanical Name
18	Cockscomb	*Celosia cristata*
19	Cockscomb	*Celosia plumosa*
20	Floss flower	*Ageratum mexicanum*
21	Canna (red)	*Canna* hybrids
22	Canna (yellow)	*Canna* hybrids
23	Copperleaf (red)	*Acalypha Wilkesiana*
24	Begonia	*Begonia semperflorens* var. "Vernon"
25	Coleus (red)	*Coleus Vershaffeltii*
26	Virgin's-bower	*Clematis paniculata*

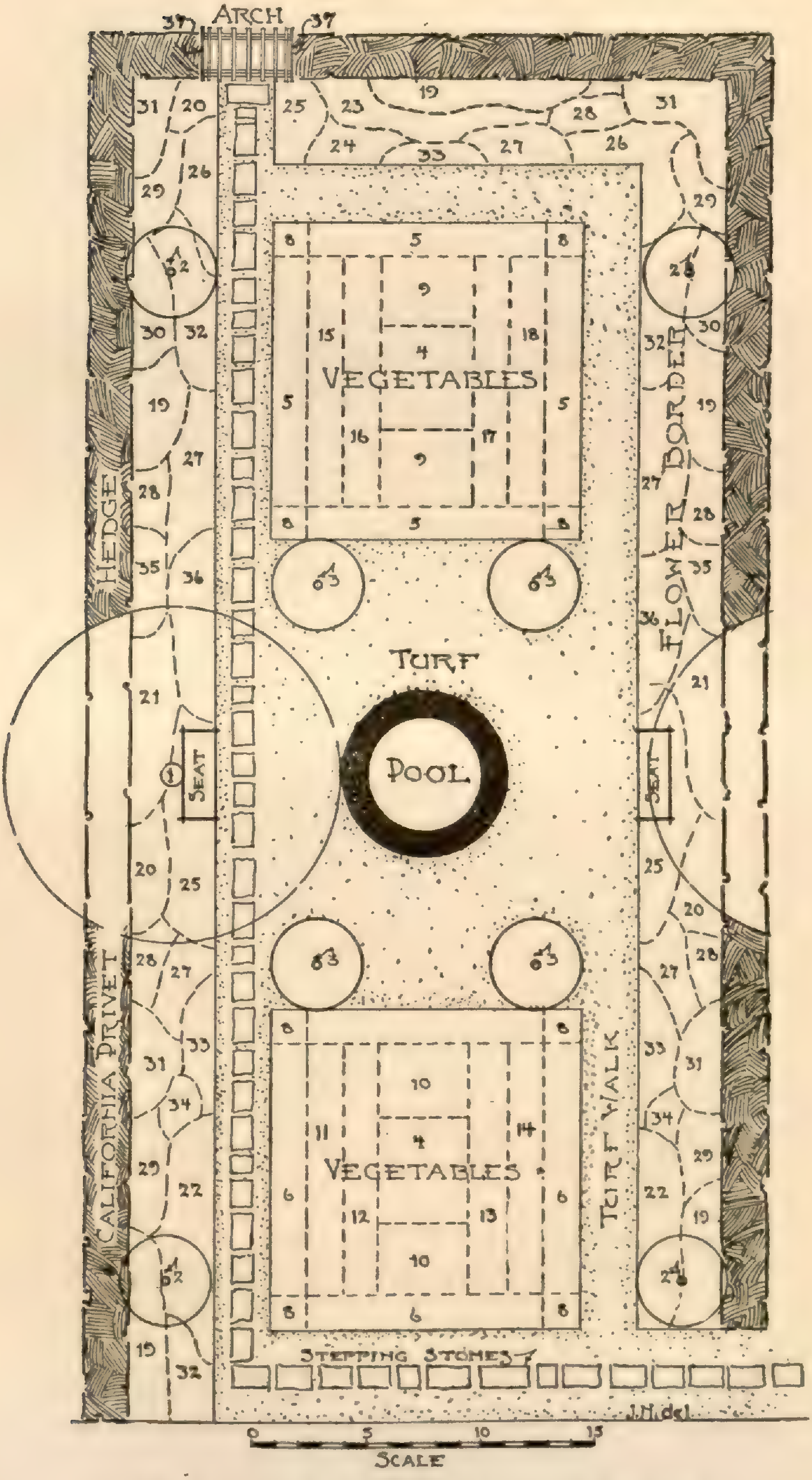

ARCH
37
37
31
20
26
29
62
30
32
19
27
28
35
36
21
1
SEAT
20
25
28
27
33
31
34
29
22
62
19
32
25
23
19
28
31
24
33
27
26
29
8
5
8
9
15
4
18
VEGETABLES
5
5
16
17
9
8
5
8
63
63
TURF
POOL
63
63
8
8
10
11
4
14
VEGETABLES
6
6
12
13
10
8
6
8
HEDGE
CALIFORNIA PRIVET
FLOWER BORDER
TURF WALK
28
32
30
19
27
28
35
36
21
SEAT
25
20
27
28
33
31
34
29
22
19
24
STEPPING STONES
J.H. del.
0
5
10
15
SCALE

Fig. 1. Plan of flower and vegetable garden.

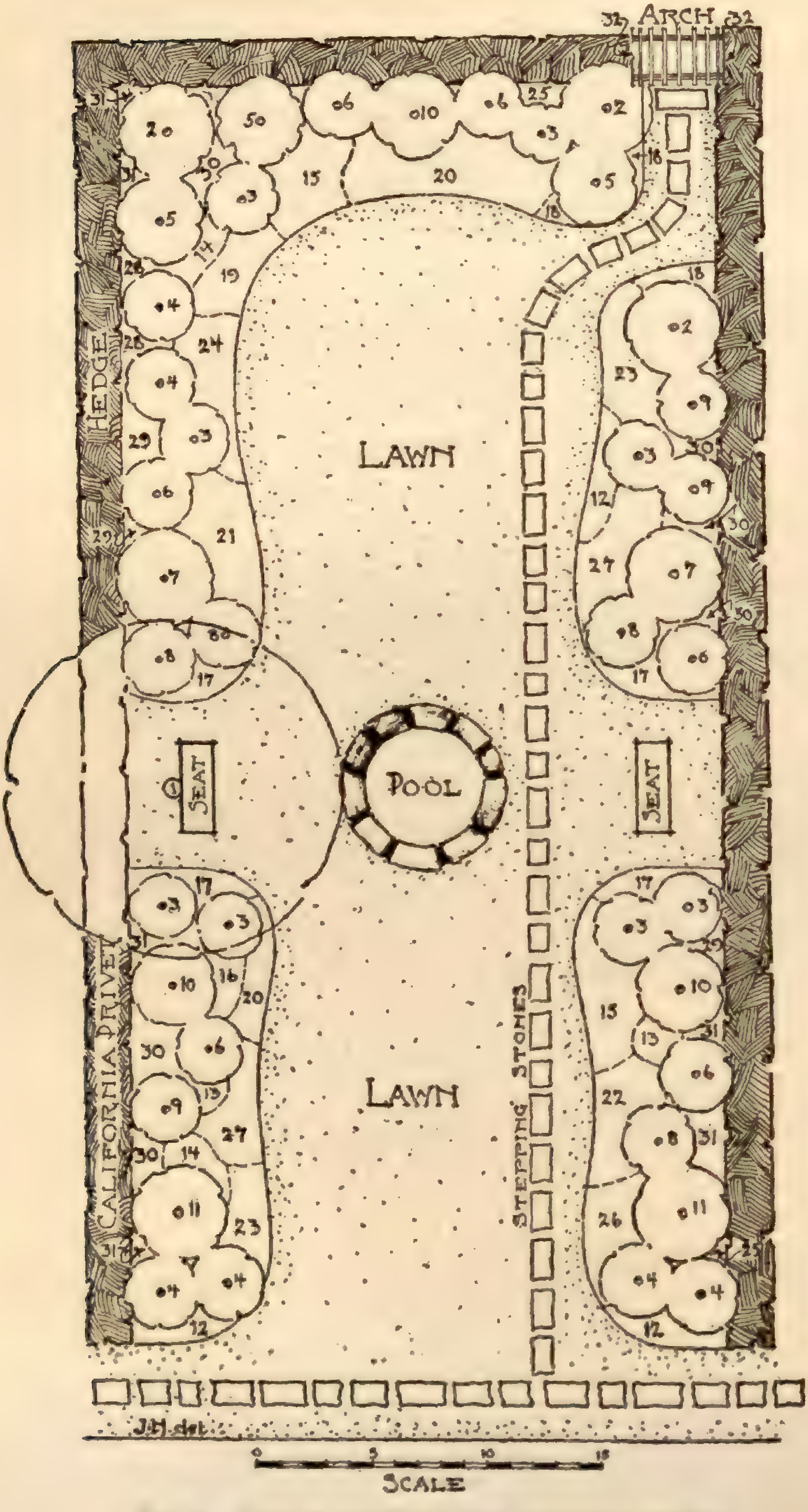

32
ARCH
32
31
20
50
6
10
6
25
2
3
18
5
31
30
3
15
20
5
18
14
19
28
4
28
24
18
2
HEDGE
4
23
9
29
3
30
3
6
LAWN
12
9
29
21
30
27
7
7
30
80
8
8
6
17
17
POOL
SEAT
SEAT
17
3
3
17
3
3
31
29
10
16
20
10
15
13
31
30
6
6
9
13
22
8
27
LAWN
31
30
14
STEPPING STONES
CALIFORNIA PRIVET
11
23
26
11
31
4
4
25
4
4
12
12
J.H. del.
0
5
10
15
SCALE

Fig. 2. Plan of shrubbery and perennial garden.

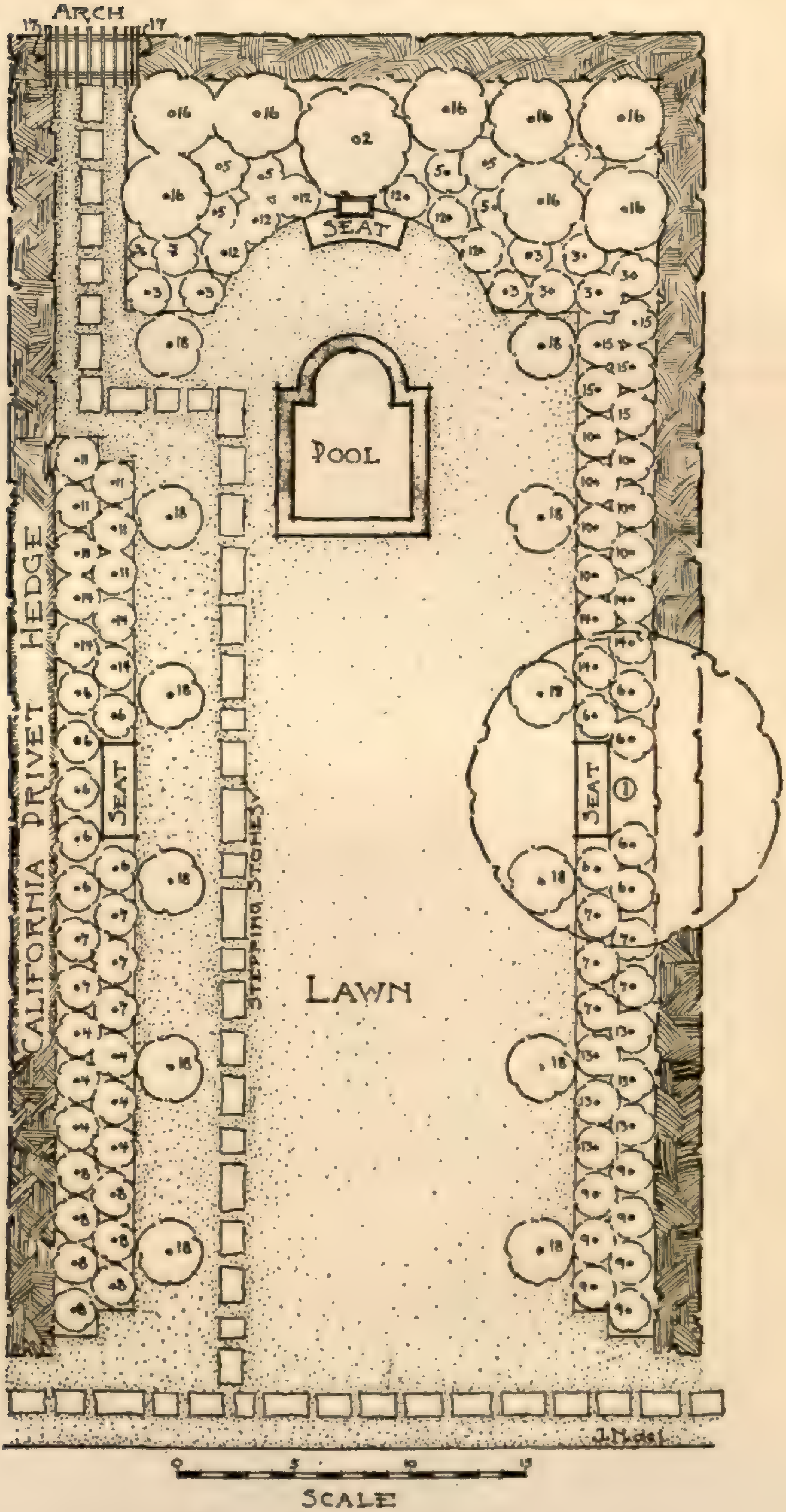

ARCH
17
17
SEAT
POOL
CALIFORNIA PRIVET HEDGE
SEAT
SEAT
STEPPING STONES
LAWN
J.N. del.
0
5
10
15
SCALE

Fig. 3. Plan of rose garden.

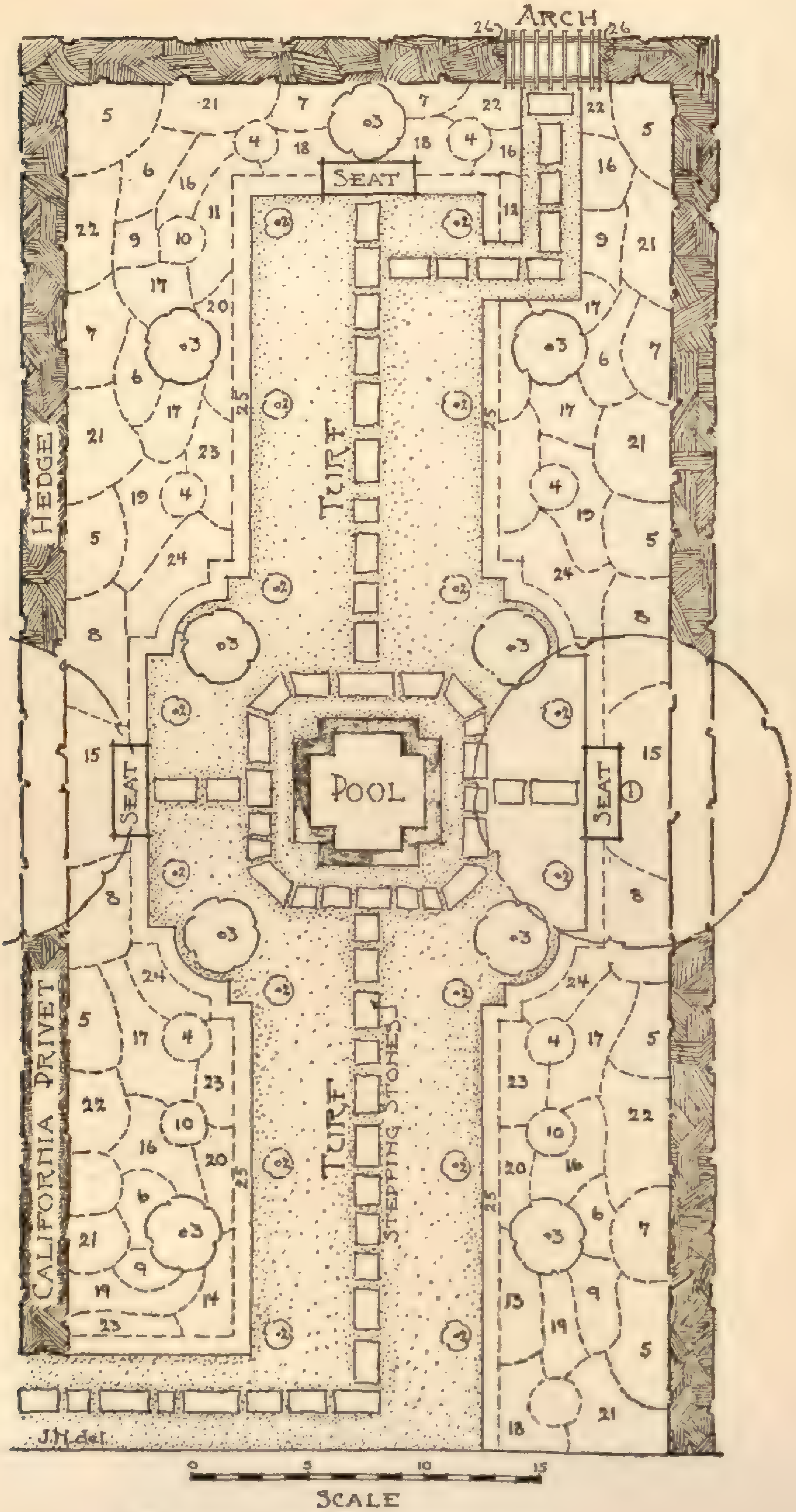

ARCH
26
26
SEAT
TURF
POOL
SEAT
SEAT
HEDGE
CALIFORNIA PRIVET
TURF
STEPPING STONES
J.H. del.
0
5
10
15
SCALE

Fig. 4. Plan of subtropical garden.

NOTES

Both bluebirds and robins were observed in the Garden on Sunday, February 17.

Prof. Laurenz Green, of the Iowa Agricultural Experiment Station, Ames, Iowa, visited the Garden on January 25.

Mr. Fred G. Grossart, a former Garden pupil, has been appointed Head Gardener, University of Nebraska, Lincoln, Nebraska.

Mr. Max Geisler, a graduate of Iowa State College, has recently been placed in charge of the trees and shrubs at the Garden.

The fourth number of Volume III of the Annals of the Missouri Botanical Garden has recently been issued with the following contents:

"Pistillaria (subg. Pistillina) Thaxteri, Burt n. sp." E. A. Burt.

"A Note on the Adaptability of the Folin Micro-Kjeldahl Apparatus for Plant Work." A. R. Davis.

"Studies in the Physiology of the Fungi. I. Nitrogen Fixation." B. M. Duggar and A. R. Davis.

"Studies in the Physiology of the Fungi. II. Lenzites saepiaria Fries, with Special Reference to Enzyme Activity." S. M. Zeller.

Mr. J. Francis Macbride, of the Gray Herbarium of Harvard University, recently spent a day in the Garden Herbarium examining material of the Boraginaceae.

A lecture on "Native Aquatic Plants Adapted to Aquaria" was given before the St. Louis Aquarium Society at the American Hotel by Mr. G. H. Pring, in charge of conservatories, on February 13.

Mr. Alexander Lurie, Horticulturist to the Garden, spoke before the Mothers' Club of the Benton School, January 19, on "Outdoor Flowers" and before the Mothers' Club of the Devonshire School, February 16, on "Back Yard Gardens."

On February 1 Dr. George T. Moore, Director of the Garden, addressed the Phi Gamma Delta fraternity on "The Garden and the Town"; and on February 7 spoke before the Wednesday Club on "New Fruits and Vegetables for the St. Louis Market."

The St. Louis College of Pharmacy, comprising 65 students, visited the Garden on January 25. Mr. G. H. Pring, in charge of conservatories, conducted them through the greenhouses and grounds and gave special attention to the economic plants of medicinal value.

The floral display for the month of March will be the most effective of any held during the winter, consisting for the most part of about 1800 plants of cineraria, a daisy-like flower varying in color from white through all shades of red to the deepest purple. Because of the strong color of these flowers they will be massed very much to themselves, but about an equal number of snapdragons, marguerites, and stocks will be used for the background. On the balcony will be shown some of the newest types of freesia, i.e., the pink and lavender sorts, as well as the greatest variety of spiraea or astilbe ever seen in St. Louis. This season of the year induces in flowering plants great perfection in growth of foliage and flowers, and those placed in the floral display house this month represent some of the best that the Garden has yet produced.

STATISTICAL INFORMATION FOR JANUARY, 1917

GARDEN ATTENDANCE:	
Total number of visitors	6,800
PLANT ACCESSIONS:	
Total number of packets of seeds received in exchange	12
Total number of plants and seeds donated	13
PLANT DISTRIBUTION:	
Total number of plants distributed free	94
Total number of plants distributed in exchange	50
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	12
Total number of books and pamphlets donated	126
HERBARIUM ACCESSIONS:	
By Purchase —	
Rev. John Davis—Plants of Missouri	300
Dr. C. F. Millspaugh—Plants of Yucatan, collected by Dr. C. F. Gaumer	143
By Exchange —	
New York Botanical Garden—Plants of Bermuda	121
By Gift —	
Dr. Adolf Alt—Plants of Switzerland	65
Dr. H. J. Banker—*Stereum spadiceum* from Long Island	1
E. Bartholomew—*Stereum rameale* from Louisiana	1
G. H. Burnham—Fungi of the region of Lake George, N. Y.	11
C. W. Dodge—*Trimmatostroma americana* Thüm. from Vermont	1
J. A. Drushel—Plants of the United States	11
H. M. Jennison—Pyrenomycetous fungi from Montana	2
O. S. Ledman—*Crotalaria sagittalis* L. from Missouri	1
Dr. G. L. Peltier—*Septobasidium retiforme* on apple bark from Alabama	1
Dr. J. B. Rorer—*Septobasidium lilacinum* Burt, covering trunks of orange trees in Trinidad from the ground to the tops	1
Prof. L. B. Walker—*Merulius irpicinus* from greenhouse in Lincoln, Neb.	1
TOTAL	660

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

BENJAMIN MINGE DUGGAR,
Physiologist, in charge of Graduate Laboratory

HERMANN VON SCHRENK,
Pathologist.

JESSE M. GREENMAN,
Curator of the Herbarium.

EDWARD A. BURT,
Mycologist and Librarian.

J. C. TH. UPHOF,
Assistant Botanist.

GEORGE W. FREIBERG,
Research Assistant.

KATHERINE H. LEIGH,
Secretary to the Director.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

JOHN NOYES,
Landscape Designer.

ALEXANDER LURIE,
Horticulturist.

A. B. MCINTYRE,
Outdoor Gardens.

J. J. COUGHLIN,
Construction.

P. FOERSTER,
Farm and Stables.

W. F. LANGAN,
Engineer.

G. H. PRING,
Conservatories.

M. SCHILLER,
Floral Displays.

MISSOURI BOTANICAL GARDEN BULLETIN

ALUMNI NUMBER

Vol. V MARCH, 1917 No. 3

CONTENTS

Page
Greetings from the President of the Alumni Association 49
Floricultural Education - - - - - - - - 50
Commercial Floriculture in England vs. the United States 54
Retail Florists' Stores - - - - - - - 55
Some Practical Observations on Ends and Walls - - 58
Notes from the Secretary's Desk - - - - 60
Notes - - - - - - - - - - 61
Statistical Information - - - - - - - 63

ST. LOUIS, MO.
1917
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

BOARD OF TRUSTEES OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

EDWARD C. ELIOT.

LEONARD MATTHEWS.

GEORGE C. HITCHCOCK.

WILLIAM H. H. PETTUS.

P. CHOUTEAU MAFFITT.

PHILIP C. SCANLAN.

EDWARD MALLINCKRODT.

JOHN F. SHEPLEY.

EX-OFFICIO MEMBERS

EDMUND A. ENGLER,
President of The Academy of Science of St. Louis.

HENRY W. KIEL,
Mayor of the City of St. Louis.

FREDERIC A. HALL,
Chancellor of Washington University.

BENJAMIN P. STROMBERG,
President of the Board of Public Schools of St. Louis.

DANIEL S. TUTTLE,
Bishop of the Diocese of Missouri.

R. W. SWITZER, Secretary.

PERENNIAL GARDEN AT MASSACHUSETTS AGRICULTURAL COLLEGE, PLANTED BY STUDENTS.

STUDENTS STUDYING VARIETIES AT MASSACHUSETTS AGRICULTURAL COLLEGE.

Missouri Botanical Garden Bulletin
ALUMNI NUMBER

Vol. V St. Louis, Mo., March, 1917 No. 3

GREETINGS FROM THE PRESIDENT OF THE ALUMNI ASSOCIATION

Again it becomes my privilege as president of the Garden Alumni Association to contribute a few lines to the annual publication of our organization, and to extend to all members my sincere greetings and the wish that the year 1917 may bring them much joy and success in their various fields of endeavor.

Our organization has passed the critical stage of its existence and has demonstrated clearly that it can be of great benefit to the alumni of the Garden. However, in order to do still greater things we need the continued coöperation of all members, and I beg them to respond when called upon by the officers for assistance. The secretary has already issued a call for the next meeting. There is some important work to be done at this meeting, and every member must participate in the discussions if he is to share in the resulting benefits. This is a day of specialization and organization, and very little can be accomplished through individual effort.

The profession of horticulture, with all its branches, has never been in a more flourishing state than now. With the great demand by the public for cut flowers and the growing custom of establishing private estates with greenhouses and gardens, there is an ever-increasing call for men educated along practical and scientific lines. Here in New England we have always depended somewhat on the man trained in Europe, but since the beginning of the war none have come to fill the many vacancies which have occurred. At the close of the war the few trained men who will be left will be needed in their own countries, but by that time the American horticulturists, if they have taken advantage of their opportunities, will have developed their own ideas and methods and will not be dependent upon help from abroad.

ARNO H. NEHRLING,
President, Missouri Botanical Garden
Alumni Association.

FLORICULTURAL EDUCATION

We are living in an age of intense specialization. This specialization is very apparent in all phases of agricultural work, but in horticulture it has been most marked. So rapidly has this branch developed that in the last twenty-five years it became necessary to divide it into the separate or special departments, such as pomology, landscape gardening, olericulture, forestry, and floriculture. Of these highly developed departments, none has progressed as rapidly as floriculture, and this has to some extent been due to the men who have been trained along practical and scientific lines.

In order to appreciate fully the subject of floricultural education and the methods that are being followed by our American agricultural colleges, it is necessary to have a conception of the nature and scope of the institutions carrying on this work. An agitation for agricultural schools was brought about by the agricultural societies which came into life late in the eighteenth century, immediately following the American Revolution, and a number of such institutions were established, one in Maine in 1821 and one in Connecticut in 1824. The natural conditions, however, did not seem to justify this movement on an extensive scale, and it was not until the great West began to develop, in the late forties and fifties, that the demand for agricultural schools became apparent. At this time higher education was primarily the business of the church, and colleges existed on private subscription. Pennsylvania and New York had agricultural colleges, but as both were supported by private donations, their existence was a struggle and came to an abrupt end at the beginning of the Civil War. Only one state, namely, Michigan, fared a little better. Here, in 1850, about the time the agitation was at its height, some far-sighted man introduced a clause in the constitutional convention making it obligatory upon the state to establish and maintain a college or school of agriculture, and in 1857 the college was opened for students. Many of our pioneer agriculturists, among them L. H. Bailey, Eugene Davenport, and President Butterfield of Massachusetts Agricultural College, received their education at this institution.

Further development occurred in 1837 when Justin P. Morrill, then a member from Vermont serving in the lower house, introduced into Congress a bill providing a grant of land to each state for the purpose of establishing agricultural and industrial institutions. The bill had the usual experience of new projects. Once it passed both houses, but was promptly vetoed by President Buchanan. It passed again, however, and was approved by President Lincoln, July 22, 1862. Thus did the United States in the early days of the Civil War lay the foundation for a national system of agricultural and industrial education, and thus originated the so-called land-grant college.

Each state accepted the lands and proceeded to establish its college according to local conditions and its peculiar interpretation of the Morrill Act. In the East the land grant was turned over to existing institutions, whose faculties knew little and cared less about what the law intended to accomplish. In the West the funds were generally used to start universities that too often devoted their energies to the interest of general education rather than to the peculiar educational ideals which the Morrill Act was supposed to establish. In the Middle West an intermediate course was pursued. Michigan and Pennsylvania already possessed each an agricultural college, and in both cases the proceeds of the land grant were turned over to these institutions, and all energies were devoted to agriculture, ignoring for many years the mechanical interests provided for in the act. These new institutions simply did the best they were able, as they were without teachers, without matter, methods, or ideals, and, above all, without an enthusiastic clientele, for farmers at that time generally ridiculed book-farming. That this is not the case to-day, however, is clearly illustrated by the large attendance at the various colleges of agriculture.

At the Massachusetts Agricultural College, courses in botany and horticulture were offered by Prof. Clark, then president of the college, as early as 1878. In 1896 all the so-called horticultural work was turned over to Prof. Maynard, this including pomology, floriculture, market gardening, forestry, plant breeding, etc. In 1902 Prof. Waugh came to the college to take charge of these courses, and the actual advancement dates from that period. The time soon came when he could not handle all this work, and in 1904 the floricultural department was turned over to Mr. Francis Canning. On account of the popular demand for this branch of horticulture, and realizing the value of men trained along this line, in the fall of 1906 the college began offering a specialized course in floriculture under the direction of Prof. E. A. White. In 1908 the courses became still more specialized, and from the meager beginning in 1878 has developed the present department of floriculture.

About this time a number of other state institutions began to divide up the horticultural work. Illinois, in 1908, established a division of floriculture, and Cornell, although more or less complete courses in floriculture had been given under Prof. Bailey's direction, has since developed a strong department. Other institutions are offering work along floricultural lines, but the work is not as highly specialized as in these three colleges. Before this, however, that man of broad vision, Henry Shaw, to whom we Garden students are directly responsible for our training, realized the fact that there would be a demand for men educated along practical and scientific lines. He made this fact known when, in his will, dated January 26, 1885, he inserted this paragraph:

> "I declare my intentions that instruction to garden pupils shall be attended to, both in practical and scientific horticulture, agriculture and arboriculture. I leave the details of instruction to those who may have to administer the establishment, and to shape the particular course of things to the condition of the times."

The Board of Trustees, on assuming control of the Garden, gave this feature of Mr. Shaw's will their very early consideration. In December, 1889, the first announcement concerning Garden pupils was issued. In this we find the following: "In accordance with the intentions of its Founder, the Trustees of the Garden propose to provide adequate theoretical and practical instruction for young men desirous of becoming gardeners."

The system followed in the work at the Garden in the early days was modeled after that in use at the Kew Gardens, England, and floriculture was from the very beginning one of the most important phases. This system has been giving excellent results, and has actually been the foundation for the courses offered by our agricultural colleges to-day. The important factor in the instruction at the Garden is the emphasis that is placed on the practical work, as this gives the student the assurance and confidence that he understands the tasks set before him and the best way to acomplish them.

The courses offered to-day by the progressive institutions include work in greenhouse management, commercial floriculture, greenhouse construction, garden flowers and bedding plants, conservatory work, floral decorations, and retail store management. Great emphasis is placed on the commercial side of floriculture; nevertheless, the courses will serve as a foundation for the student who wishes to go into private garden, park, or cemetery work. In addition to the collegiate work, the department at the Massachusetts Agricultural College offers a special ten-weeks' course in commercial floriculture, which has become so well patronized that it has been necessary to limit the number of students. Two short courses, one in amateur floriculture and one in garden flowers, are also given during the summer months for the benefit of those who cannot attend the regular courses.

Another line of educational work which has become extremely popular in New England is that of carrying information directly to the people, in the form of lectures and demonstrations. This is known technically as extension work, and the department of floriculture at the Massachusetts Agricultural College has more requests from garden clubs, etc., for this type of work than it can conveniently handle. However, it is of utmost value in educating the people along all lines of floriculture. At this point I cannot refrain from mentioning some of the handicaps that the average state institution encounters in teaching courses in floriculture. The most serious is the lack of equipment, as it is impossible to give practical instruction to 40 or 50 students in a few small greenhouses. Another difficulty is the fact that the school year ends at the time when some of the most important details in the culture of plants must be attended to in order to carry on the work another season. There are many other handicaps, but these two, to my mind, are the most serious.

In summing up the entire subject we find that floricultural work, as outlined in this discussion, is a comparatively new venture, and only approaches the apprentice system, under which our successful gardeners and florists received their training. The man in demand at the present time is the man proficient in theory and practice, and we Garden students have had the good fortune of being trained under a system which is a combination of both, namely, the college and the practical work. The college graduate must obtain this practice after graduation, while the Garden student, if he takes advantage of the wonderful opportunities placed at his disposal, is ready to forge ahead from the outset.

After eight years of agricultural college work, let me say that if I were to start over again and had my choice between the agricultural college and the course offered to a limited number of students at the Missouri Botanical Garden, I would choose the latter.

ARNO H. NEHRLING, '09.

COMMERCIAL FLORICULTURE IN ENGLAND VS. THE UNITED STATES

Although it is more than a decade since my visit to England and doubtless many of my impressions are out of date, nevertheless a comparison between commercial floriculture in England and the United States at that time might be of interest.

The retail florist here plies a more extensive trade than in England, and his equipment is the best and most elaborate that money can buy. I saw only a few flower shops in London, and their furnishings were always meager and in a dilapidated condition. Much of the retail business was done by the street peddler, but whereas in this country his stock in trade is mostly cut flowers, in London he sells potted plants — generally ferns, palms, cypress, etc. — obtained at Covent Gardens Market. The peddling is done from house to house in small hand barrows or donkey carts.

In England the small retail grower often leads a hand-to-mouth existence. If he lives in the city he is usually very much cramped for room, and his efforts must be confined primarily to the common run of bedding plants, geraniums, lobelias, etc. He caters to the poorer classes of working people, and is obliged to sell at a ridiculously low figure. Sometimes, though, as in this country, the florist conducts a thriving seed business in connection with his greenhouse trade, and there are many extensive suburban establishments which turn out vast quantities of the best quality stock. I have never seen finer cyclamen, cinerarias, begonias (tuberous), pelargoniums, fuchsias, baronias, ericas, and calceolarias than in England. As transportation facilities are excellent, trains being run every few minutes and country roads being always dependable, much of this product finds its way to London at the Covent Gardens Market, a scene of indescribable activity in the early morning hours. The big firms with which most florists are familiar, on account of their wide-spread advertising, generally specialize in, or devote much time to, the testing and introduction of novelties. Their market is the world and their business is very remunerative.

The growing of cut flowers under glass is conducted on a very different basis in England than in the United States; they have no such enormous establishments devoted to roses, carnations, etc. Their pot roses are large, and they have wonderful Malmaison carnations with very large flowers of many colors, but with the serious defect of bursting their calyx. However, they are now growing many varieties of

American origin. Bench culture of cut flowers — a feature in which we have unquestionably achieved a high degree of perfection — has not proven very satisfactory in England because of the weather conditions. Bulb-forcing on a large scale is common, at least in the immediate vicinity of London, and has become a highly successful and specialized industry. Outdoor formal bedding of tulips and hyacinths is very general, and the results obtained by planting narcissi, scillas, snowdrops, crocuses, etc., informally in lawns, are very wonderful, far surpassing anything that we have here. On account of the ideal weather conditions the cultivation of hardy perennials comprises no small portion of the florist's business, and it is indeed a very poor garden that does not possess a good and varied collection of such plants, while in this country our knowledge of them is almost entirely confined to paeonies, phlox, iris, and hollyhocks. Alpine and rock plants, of which we know practically nothing, are especially featured by some of the leading firms.

To sum up: In America, floriculture is practised on a larger scale, but in England the people have a wider and more intimate knowledge of plants and their requirements and the profession as a whole is on a much higher plane.

OTTO BOGULA, '97.

RETAIL FLORISTS' STORES

The retail flower business of to-day is quite different from what it was in the past. A few years ago it was considered outside the florist's trade to carry anything beside flowers or material directly connected with them; but now the up-to-date florist will supply the sun-parlor not only with plants but also with bird-cages, chairs, tables, fountain aquariums, goldfish, and artificial flowers, while for the garden he will furnish cement benches, sun-dials, gazing-globes, and many other novelties. Moreover, such a diversified stock does not in any way interfere with the sale of fresh flowers, but rather encourages it, as it attracts a wider class of people into the store.

A retail flower shop should at all times be a place of beauty. The plants in the store should be fresh, the pots covered, the cut flowers neatly arranged in vases or baskets, and the workroom separated from the salesroom by at least a screen.

Buying. — A good buyer is of the utmost importance in conducting a retail business. The proprietor should do his own buying, as he is in the best position to know just what the trade demands, but if this is not possible, the buyer should be a conscientious employe, one who has the store's interest at heart and is a good judge of values and qualities.

Salesmanship. — Salesmanship is no small item in establishing the success of a retail flower store. No matter how good the stock or how fine the location, one must have a good salesman in order to draw the trade. He should at all times be courteous and ready and willing to show the stock; he should be able to arrange the plants in an attractive manner, be a good judge of their appropriateness for special occasions, and he should know enough about them to be able to give advice and suggestions concerning their care. Moreover, he should never sell or promise anything not in stock or that there is the slightest doubt about securing in time, for misrepresentation and unreliability do more injury to a business than anything else.

Special Days. — Certain days have become very important in the florist's business, and by special displays in the window they can be brought more forcibly to the attention of the people. This is especially true of St. Valentine's Day, and an exhibit consisting of heart-shaped boxes and baskets, hearts and arrows attached to basket handles, etc., is a good method of advertising, and can be made very decorative. One florist conceived the idea of using the red frieze left from Christmas in his Valentine display. A heart-shaped wire covered with the frieze, with a ring at the bottom to hold a plant or vase of cut flowers, made quite an addition to his window and gave him "something different."

Millions of shamrocks are grown especially for the florist's trade at St. Patrick's Day, and some very clever novelties are introduced every year, among which are the castle and harp, pottery in the shape of shamrocks, and boxes with verses from the Emerald Isle on the cover. The popularity of flowers at Easter is well known, and Mother's Day (second Sunday in May) is fast becoming one of the big flower days. The latter needs some advertising, but window decorations suitable to the occasion will always bring a large number of orders. Decoration Day, like Easter, needs no introduction to flower buyers, but it is a good plan to arrange the window display early.

During the summer, when business is dull and there are no special days, the florist's attention may be turned to weddings and graduations. For the wedding display a figure dressed in bride's costume, which may be rented at a small cost from a department store, may be used, and other figures to represent the wedding party make it still more attractive. At a recent exhibition held by the retail florists of Chicago this idea was effectively carried out in miniature as a table decoration, dolls and small arches of Cecile Brunner roses and lily-of-the-valley being used.

There are no special days in September, but some stores have a large trade by catering to the parties of the debutante, and it is a much better month than formerly. Christmas is always a busy time.

Florists' Telegraph Delivery Association. — One of the best organizations in recent years and which grows more important every year is the Florists' Telegraph Delivery Association. This is composed of retail florists of Canada and the United States, who are members in good standing in the Society of American Florists and Ornamental Horticulturists. The dues depend upon the population of the city or town, the minimum being twenty dollars and the maximum thirty dollars, and when admitted to the association each member must place on deposit a guarantee fee to insure the payment of accounts contracted between members.

Advertising. — In this day of competition among retail stores, advertising is a great consideration, whether it be a small neighborhood florist or a large concern that caters to a city and suburban trade. If direct advertising is used — and it is a very good method — a neat and attractive circular or card will suffice. This could be sent before a holiday or at a time when a special bargain is to be obtained. A card index could be kept of all to whom circulars or cards have been sent, and if they have not purchased after sending a certain number their names might be dropped from the list. Window decoration as a means of advertising has already been discussed under "Special Days," but its importance should not be overlooked. The manner of packing and delivering an order could also be classed as advertising, and part of the appropriation for such purpose should be spent in attractive boxes and tags.

Indirect advertising offers a wide choice of mediums, such as posters, signboards, programs, and notices in street-cars or newspapers. Newspaper advertising is probably the best, the choice of paper depending upon its circulation, class of people reading it, and the localities reached. A large space is, of course, more desirable, as more details can be given and the principal selling points brought out, but a neat and attractive advertisement, whether large or small, is sure to bring good results.

RUDOLPH J. MOHR, '02.

SOME PRACTICAL OBSERVATIONS ON ENDS AND WALLS

It is quite evident to those of you who have been employed in greenhouses what is meant by ends and walls, but their importance is often overlooked. It has been the experience of the writer to pass through an unusually severe winter which offered the chance of seeing the benefits of things done and the unpleasant results of things undone in this regard — in other words, to see the advantages of preparedness.

Greenhouse ends, as they are usually found on the average commercial establishment, are the weakest part of the structure, especially on the older places. It seems as though they had been the last and least-considered part of the house during its erection. Even on newer structures an extremely well-braced end is seldom found, unless it is a specially designed house, and less often do we find them with double glass gables.

It has been an opportunity to observe during the season just past the ends on six greenhouses, all having a western exposure. Four of these houses were fitted with single glass, as is the common thing, and two with double glass. On very cold days, when it was 25° below zero or thereabouts, the single glass was coated with a heavy layer of frost and the only means of looking outside was through the ends which had the double glass. The two types also showed a great variation in temperature, the double glass ends being much warmer and showing a greater tendency towards uniformity and freeness from draughts. The exact records of the different temperatures were not kept because the facts were so obvious that our course on greenhouse ends for the future was immediately decided upon. However, it would be interesting to work out the differences in temperatures and also the effect upon the strength of the wall in houses with and without the double glass ends.

As was the case with the ends, our observations showed that the greenhouse walls were too thin for severe spells of cold weather. They are usually either built of single thickness with a building paper or a cement coat, or of double boards with paper between, but seldom with an air space. The neglect here is perhaps due to the fact that the early greenhouses were glass-covered dug-outs and required no material for walls; and as they were gradually built more out of, and finally on top of, the ground, the tendency was to think that the walls were still of secondary consideration. In our greenhouse frost has killed chrysanthemum plants that had been placed on a solid bench from 4 to 8 feet inside of a single wall of the type just mentioned. At that time the temperature in the house at 3 feet above the ground was 10° below freezing, while outside it was 30° below zero with a strong wind blowing. The wall was not old and was built of a good grade of lumber, was covered with tar paper with a stucco finish outside, and, we were confident, was as tight as a wall of this kind can be made. We were not decided whether the frost had penetrated the wall or the foundation or whether it had come through the ground under the shallow foundation that is usually found in greenhouses. We were sure, however, that if we had had a properly air-spaced wall we should have known under a like condition that the frost came through the ground.

Naturally, the remaining item in the discussion of a greenhouse end or wall is the foundation. Commercial greenhouse men either neglect the importance of a deep foundation or else consider it too expensive for most establishments, for it is seldom included in greenhouse equipment. It seems quite evident to the writer that if plants will freeze in extreme weather in a greenhouse with such an end as has been described, that no small part of the frost must have come through the ground under the wall; and as there must also be a considerable amount of heat escaping during milder weather, it would be advisable and economical to give more consideration to a foundation. Very often a cement base which is placed under the door-sill is raised by the frost to such an extent that the end of the house becomes warped and the glass falls out of one or more runs, making an unsightly and loose end. This, too, could be overcome by a deep foundation.

Our observations have been drawn from the experience of an unusually severe winter, the like of which we may not see for a great many years, but the lessons which it taught will be of profit for a long time to come. A thing that will not stand a severe test is very apt to be inefficient during the ordinary test, so we advise building greenhouses with deep solid foundations, with double walls with an air space between, and with double glass ends to keep out the cold. It will be found economy under the ordinary test and great satisfaction under the severe test. Every good grower knows the advantages of uniform and even heating, and although the temperature cannot be entirely regulated with the steam pipes, it can be materially helped by having good solid walls and ends. If the ends of the houses can be maintained at the same temperature as the center, equally good stock can be grown there, and in this great age of efficiency and best efforts it would seem that greenhouses and their managers are not doing their best when operating under the handicap of poor walls and ends.

ARTHUR H. SMITH, '11.

NOTES FROM THE SECRETARY'S DESK

Word has just been received that Profesor Arno H. Nehrling, our president, has resigned his position as head of the department of floriculture at the Massachusetts Agricultural College to become president and general manager of the McDonald Floral Company, at Crawfordsville, Indiana. In addition to conducting a general wholesale and retail florist business Mr. Nehrling will open a landscape service bureau. All the members of the Alumni Association no doubt feel as I do, that with his usual aggressiveness, forethought, and the determination to succeed, he will keep on climbing as in the past, and will join me in wishing him success.

Since the last alumni number of the BULLETIN two of our associate members have completed the Garden course—Carl F. Giebel and Nestor S. Philippi. Mr. Giebel is now associated with Charles W. Fullgraff, '04, landscape architect, 1104 Chemical Building, St. Louis, and Mr. Philippi has taken charge of the greenhouse and campus of the University of Michigan, Ann Arbor.

Fred G. Grossart, '15, until recently head gardener, Valhalla Cemetery, St. Louis, is now engaged as a landscape gardener at the University of Nebraska.

On September 1, 1916, your secretary resigned his position as superintendent of Mt. Greenwood Cemetery, Morgan Park, Chicago, and opened his own office at 848 Penobscot Building, Detroit, for the practice of landscape gardening. He is, however, still retained as consulting landscape gardener of Mt. Greenwood Cemetery.

To all those who have not had the announcement of the next meeting framed and hung where it will attract attention, we will repeat that our next meeting is to be held at the Garden on November 16 and 17, 1917. This meeting will be a "rouser." Arrange to come, and bring your classmate with you. Remember the date — November 16 and 17. With best wishes for a successful year, I remain,

Sincerely yours,

A. R. GROSS, '91,

Secretary-Treasurer, Missouri Botanical Garden Alumni Association.

NOTES

On March 16, Mr. Thurston, Instructor in Floriculture, Iowa State College, visited the Garden.

Mr. Alexander Lurie, Horticulturist to the Garden, gave a talk on "Hot-beds" before the Webster Groves Garden Club, March 13.

Mr. Harland Bartholomew, Engineer for the City Plan Commission, addressed the Hortus Club on "City Planning," February 26.

Dr. George M. Reed, Professor of Botany at the University of Missouri, recently spent a day at the Garden, en route to New York where he will spend some months in the Brooklyn Botanic Garden.

Dr. B. M. Duggar, Physiologist to the Garden, lectured before the Alumni Association of the Washington University Dental School, March 16, on "Some Phases of Parasitism and Immunity in Plants."

On March 16, at the St. Louis Flower Show, Mr. G. H. Pring, in charge of conservatories at the Garden, gave a talk on "Aquatic Plants for St. Louis," and Mr. Alexander Lurie, Horticulturist to the Garden, spoke on "Back-Yard Gardens."

On Saturdays and Sundays during April there will be a bird walk at the Garden; on Saturdays commencing at the main gate at 9 A. M., conducted by Dr. Charles H. Danforth and Mr. Robert W. Barrell, and on Sundays at 8:30, conducted by Mr. George F. Tatum and Mr. R. F. O'Neal.

The first number of Volume IV of the Annals of the Missouri Botanical Garden has been issued with the following contents:

"Hybrid Nymphaeas." G. H. Pring.

"Monograph of the North and Central American Species of the Genus Senecio—Part II." J. M. Greenman.

"A Spurless Variety of Habenaria psycodes." Mary M. Bryan.

"A Systematic Study of the Genus Trillium, Its Variability and Its Relation to Paris and Medeola." R. R. Gates.

The first St. Louis flower show in seven years was held at Armory Hall, March 15-18, under the auspices of the St. Louis Spring Flower Show Association, and was a great success. The Garden was represented by a number of displays not in competition for a prize, and in addition by the following plants for which the first prize was awarded:

Specimen staghorn fern.
Best collection of Dracaena staged for effect.
Best foliage plant not previously exhibited in the United States—Silver medal of the Society of American Florists and Ornamental Horticulturists.
Pair of pyramidal boxwoods.
Best collection of trained boxwood.
Six plants of Anthurium.
Bougainvillea specimen.
Twelve plants of *Cineraria stellata.*
Twelve plants of *Cineraria hybrida.*
Twelve plants of Cyclamen.
Erica specimen.
Genista specimen.
Best collection of orchids.
Three orchid plants in variety.
Cattleya specimen.
Six plants of Cypripedium.
Cypripedium specimen.
Vanda specimen.
Coryanthen specimen.
The best carpet bed.

STATISTICAL INFORMATION FOR FEBRUARY, 1917

GARDEN ATTENDANCE:	
Total number of visitors	6,978
PLANT ACCESSIONS:	
Total number of plants and seeds donated	42
LIBRARY ACCESSIONS:	
Total number of books and pamphlets bought	31
Total number of books and pamphlets donated	52
HERBARIUM ACCESSIONS:	
By Purchase —	
W. E. Blach—Photographs of orchids of Vermont	40
Dulau & Co.—"Hepaticae europaeae" Dec. I-LXVI, von Gottsche & Rabenhorst	660
By Exchange —	
N. Y. Botanical Garden—Plants of Jamaica, mainly grasses, collected by Wm. Harris	67
N. Y. Botanical Garden—Scrophulariaceae of the Rocky Mountains, collected by Dr. F. W. Pennell	68
U. S. National Museum—Plants of western United States	181
By Gift —	
J. A. Drushel—Plants of the United States	16
R. A. Harper—Fungi from Florida	9
Father Jerome—*Metrosideros Newellana* from the Hawaiian Islands	1
A. B. Massey—*Septobasidium retiforme* on living branches of *Prunus*	1
L. O. Overholts—Wood-destroying fungi from Pennsylvania	3
G. L. Peltier—Parasitic and wood-destroying fungi from Alabama	3
The Rocky Mountain Herbarium—Type specimen of *Mertensia aliena* Macbr. & Payson	1
H. von Schrenk—High humidity form of *Lenzites saepiaria*	1
F. L. Stevens—Specimens from Porto Rico for study of the Pellicularia disease of the coffee plant	1
J. A. Stevenson—Fungi of Porto Rico	19
Leop. B. Strube—*Ochroma lagopus* Sw., the "balsa wood," from Porto Rico	1
TOTAL	1,072

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

BENJAMIN MINGE DUGGAR, Physiologist in charge of Graduate Laboratory.	EDWARD A. BURT, Mycologist and Librarian.
HERMANN VON SCHRENK, Pathologist.	J. C. TH. UPHOF, Assistant Botanist.
JESSE M. GREENMAN, Curator of the Herbarium.	GEORGE W. FREIBERG, Research Assistant.

KATHERINE H. LEIGH,
Secretary to the Director.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

JOHN NOYES,
Landscape Designer.

ALEXANDER LURIE,
Horticulturist.

A. B. MCINTYRE, Outdoor Gardens.	W. F. LANGAN, Engineer.
J. J. COUGHLIN, Construction.	G. H. PRING, Conservatories.
P. FOERSTER, Farm and Stables.	M. SCHILLER, Floral Displays.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. V APRIL, 1917 No. 4

MISSOVRI BOTANICAL GARDEN
1889

CONTENTS

	Page
The Spring Vegetable Garden	65
Canning Vegetables	73
Notes	77
Statistical Information	79

ST. LOUIS, MO.
1917
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

Edward C. Eliot.

George C. Hitchcock.

P. Chouteau Maffitt.

Edward Mallinckrodt.

Leonard Matthews.

William H. H. Pettus.

Philip C. Scanlan.

John F. Shepley.

EX-OFFICIO MEMBERS

Edmund A. Engler,
President of The Academy of Science of St. Louis.

Henry W. Kiel,
Mayor of the City of St. Louis.

Frederic A. Hall,
Chancellor of Washington University.

Benjamin P. Stromberg,
President of the Board of Public Schools of St. Louis.

Daniel S. Tuttle,
Bishop of the Diocese of Missouri.

Roland W. Switzer, Secretary.

Missouri Botanical
Garden Bulletin

Vol. V St. Louis, Mo., April, 1917 No. 4

THE SPRING VEGETABLE GARDEN

The home vegetable garden is an important economic factor for the city family in these days of rapidly increasing cost of living. In fact, it is almost a necessity at the present time to utilize all available space in the production of foodstuffs. To the average person the undertaking of growing vegetables seems appalling, because of the overestimated cost, the time necessary, and the intricacies of plant growth. However, the first cost of fitting the soil of an average back yard and buying of the seed will not exceed ten dollars, while in a good many cases it may be done for half the sum, and any one with sufficient ambition can perform all the labor necessary after work hours. In addition to the economic factor involved, the real dietetic value of fresh vegetables, the benefits derived from healthful exercise in the open air, and the pleasure of seeing plants develop from day to day should influence many in starting a garden.

In planning the garden the maximum of production on a minimum of space is essential, and the ground should be fully occupied from early spring until late fall. This means that rows of vegetables should be planted close together, that short-season crops should be planted between rows, and that as soon as one crop is harvested another should take its place. Transplanting should be practised to a large extent, to save space during early growth of the plant. Extremely rapid growth is made possible by enriching the soil and applying copious quantities of water.

Since planting should be close and a large amount of edible product obtained from each square foot of ground, it will be necessary to omit from a garden of this kind some of the rank-growing vegetables which produce proportionally small returns for the amount of space occupied. Plants producing the greatest amount of edible matter in the shortest time should be given preference; that is, sweet corn, melons, squash, and others of that type may be omitted, and the garden devoted to such crops as lettuce, radishes, beets, onions, string beans, peas, tomatoes, turnips, cucumbers, etc. The accompanying plan is a suggestion for handling a plot 20 x 30 feet, sufficient to feed an average family of four. The varying tastes of individuals may require substitution wherever desirable.

The following table indicates the plants and the amounts necessary for the suggested arrangement. Seed should be sown thickly in the rows and later thinned to the proper distance apart. The time of planting is general, but will vary where succession of crops is used, as it is necessary to wait until maturity of the preceding crop before the subsequent one may be put in. No succession should be practised in rows 6, 8, and 10, in order to give the celery ample room for development. In row 14 radishes may be grown together with parsley, the latter thinned out and grown between the radishes. Rows 15–20 may be used for quickly maturing crops before the late ones are planted.

SPRING VEGETABLE GARDEN

Vegetable	Variety	Time of planting	Amt. seeds or plants per 20-ft. row	Depth of planting (inches)	Distance of plants		Yield per 20-ft. row
					In row (inches)	Bet. row (inches)	
Bean....	Stringless Green Pod	May 1	½ pt.	2	6	18	10 messes
	Kidney Wax	May 1	½ pt.	2	6	18	10 messes
Beet....	Eclipse	Apr. 1	½ oz.	¾	4	12	5 doz.
	Crosby Egyptian	Apr. 1	½ oz.	¾	4	12	5 doz.
Carrot...	Danvers Half-long	Apr. 15	¼ oz.	½	3	12	7 doz.
Cauliflower.	Early Erfurt	Apr. 15	12 plants	......	18	18	12 heads
Chard...	Lucullus	Apr. 1	¼ oz.	¾	12	12	20 heads
Cucumber...	White Spine	May 1	1 pkt.	1	36	36	120 slicing 200 pickl'g
Celery...	Golden Self-blanching	May 15	30 plants	......	9	24	30 heads
Corn....	Golden Bantam	Apr. 15	¼ pt.	1½	18	18	3 doz.
Horse-radish.	Maliner Kren	Apr. 1	10 plants	......	12	12	10 roots

1'	ONIONS followed by PEPPERS		1
1'	RADISHES followed by CARROTS		2
1'	LETTUCE followed by BEETS		3
1'	SPINACH followed by STRINGBEANS then by LETTUCE		4
1'	EARLY TURNIPS followed by RADISHES		5
1'	EARLY PEAS		6
1'	EARLY PEAS followed by CELERY		7
1'	LETTUCE		8
1'	EARLY PEAS followed by CELERY		9
1'	ONIONS		10
1'	CHARD		11
1'	PARSNIPS		12
1'	EARLY BEETS followed by STRING-BEANS		13
1'	RADISHES with PARSLEY	HORSE-RADISH	14
1½'	CAULIFLOWER		15
1½'	LATE PEAS		16
1½'	STRING BEANS		17
1½'	EARLY SWEET CORN followed by TURNIPS		18
2½'	TOMATOES		19
2½'	TOMATOES	RHUBARB	20
3'	CUCUMBERS		21
2½'			

SUGGESTIVE PLAN of VEGETABLE GARDEN
20 ft by 30 ft.

SPRING VEGETABLE GARDEN (Continued)

Vegetable	Variety	Time of planting	Amt. seeds or plants per 20-ft. row	Depth of planting (inches)	Distance of plants		Yield per 20-ft. row
					In row (inches)	Bet. row (inches)	
Lettuce..	Grand Rapids Big Boston	Apr. 1 Apr. 1	1 pkt. 1 pkt.	½ ½	4 6	12 12	30 messes 40 heads
Onion (sets).	White Yellow	Apr. 1 Apr. 1	1 pt. 1 pt.	1 1	4 4	12 12	5 doz. 5 doz.
Parsley..	Moss Curled	Apr. 1	1 pkt.	½	12	12	20 plants
Parsnip..	Hollow Crown	Apr. 1	1 pkt.	¾	4	12	5 doz.
Pea.....	Gradus Am. Wonder Laxtonia Telephone	Apr. 1 Apr. 1 Apr. 1 Apr. 1	½ pt. ½ pt. ½ pt. ½ pt.	1 1 1 1	2 2 2 2	12 12 12 12	5 messes 5 messes 5 messes 5 messes
Pepper..	Ruby King	May 15	20 plants	......	12	12	10 doz.
Radish..	French Breakfast Scarlet Short Top	Apr. 1 Apr. 1	¼ oz. ¼ oz.	¾ ¾	2 2	12 12	10 doz. 10 doz.
Rhubarb	Victory	Apr. 1	3 plants	......	36	30	....
Spinach.	New Zealand	Apr. 1	¼ oz.	¾	10	12	10 messes
Tomato.	Earliana Dwarf Stone	May 1–15 May 1–15	12 plants 12 plants	....	18 18	30 30	250 fruits 250 fruits
Turnip..	White Milan	Apr. 1	¼ oz.	¾	4	12	5 doz.

For a succession the following may be planted between the dates mentioned, using the early varieties for late planting:

SEEDS

Lettuce	April–August	Cucumbers	May–July
Radishes	April–September	Peas	April–July
Beets	April–August	Spinach	April–September
Corn	May–July	Turnips	April–August
Beans	May–August		

PLANTS

Cauliflower	April–August	Peppers	May–July
Celery	April–July	Tomatoes	May–July

The preparation of the soil, its composition, texture, and drainage are of the utmost importance in the proper growth of plants. Light and moisture also play an important part. The average back-yard soil is generally made up of a mixture of excavated subsoil obtained from the foundation digging, rubbish, ashes, and tin cans. To make it fit for plant growth the addition of available food in the form of manure or concentrated commercial fertilizers is necessary. The best time to prepare the soil is in the fall, when manure at the rate of one wagon-load to a 20 x 30-foot lot should be spaded in 6–8 inches deep. If not done in the fall the same amount of well-rotted manure should be applied in the spring. In addition to the manure, concentrated fertilizers containing the necessary constituents of plant food, nitrogen, phosphorus, and potash, should be added. Nitrogen helps in the production of foliage and comes in the form of nitrate of soda, sulphate of ammonia, tankage, etc. Phosphorus is needed for quick maturity of fruits and seeds, being commonly sold as bone meal or acid phosphate, while potash is important for the growth of root crops, like radishes, carrots, etc. All the three elements are often combined in a complete fertilizer, twenty-five pounds of which is sufficient for the plot.

The above substances are direct fertilizers, but there are soils from which the full value cannot be realized without the application of a stimulant or indirect fertilizer. Lime is used for this purpose. It sweetens sour soil, produces better drainage in clayey soil, makes loose, sandy soil more retentive of moisture, and causes certain constituents of the soil to become available to the plants. The amount of lime necessary varies according to the soil, but from 10 to 100 pounds is usually sufficient for a plot 20 x 30 feet. To determine whether the soil is sour a sample should be mixed with water to a consistency of paste, and into this a piece of blue litmus paper dropped and left for one hour. If the paper turns pink the soil is sour and lime is needed. Another method consists of stirring a teaspoonful of soil in a glass of water and then adding a teaspoonful of weak ammonia. If after standing several hours the liquid becomes dark brown or black it is an indication of soil acidity.

No part of garden work calls for nicer judgment and more careful attention than the sowing of seed. Most of the failures originate at this time, and the blame which is placed upon the seed or seedsman will generally be found to rest upon the carelessness of the gardener. A proper start for a successful garden is made by buying good seed from a reliable dealer, and unless previous testing has proved that a local grocer carries reliable seeds, he is the last one to depend upon. The seed should be bought from an accredited seed store which handles large quantities and depends upon trade by the excellence of its stock. It is well to place the order as early as possible to insure prompt service and to avoid shortage of stock which occurs almost yearly in some kinds of seed. Early ordering also gives time for testing seed for germination qualities.

In order to learn the proportion of seeds that will germinate 10–25 seeds of each kind should be counted out and placed between moist blotters between plates in a warm place. The blotters should be kept constantly moist and examined daily. At the end of 7–12 days the number of seeds germinated should be counted and the percentage calculated. One hundred per cent germination should not be expected, but it should run from 70 per cent in case of parsley, spinach, etc., to 96 per cent in radishes and peas.

Of great importance is the time at which seed are sown. There are a few seed such as beets, radishes, onions, peas, spinach, and turnips, which may be planted as early as the ground is prepared, but such early planting would result in the rotting and loss of such seed as corn, beans, tomatoes, etc. The depth of planting is influenced by the size of the seed, the soil, and the season. The larger the seed the greater power has the seedling to push its way to the surface and the deeper it may be planted. To insure sufficient moisture it is necessary to plant seed deeper in sandy than in clayey soil, for if placed too deep in clayey soil the seedling may never reach the surface because of the crust which generally forms on the top. Early in the spring the seeds should be planted shallower, because at that time the layer of soil at the surface is the warmest and most conducive to germination. In midsummer, however, when the evaporation is rapid and the heat intense the conditions for germination are likely to be more favorable at a good depth below the surface. In general practice, in medium soils small seeds like lettuce, onions, carrots, radishes, etc., should be planted ½–¾ inches deep, and large seeds, such as corn, beans, peas, should be planted 1–3 inches deep.

The distance between rows is determined by the amount of space needed by each plant for normal development and for proper cultivation. Twelve inches is a satisfactory distance for onions, carrots, lettuce, beets, etc., while other plants will require up to 40 inches. It is best to sow thick in the rows, so as to insure a full stand, and then thin out just before the plants begin to crowd. This precaution is often overlooked, with the result that the plants are undersized and sickly.

In order to secure a good crop from such plants as tomato, celery, cauliflower, etc., it is best to buy the young plants instead of sowing seed directly out of doors. In transplanting, care should be taken to keep the roots moist and pack the soil well around them, not merely bringing it around the stems and leaving the roots loose below. The compacting is necessary to bring particles of soil in intimate contact with the roots, to produce immediate growth. If transplanting is required during hot weather, the foliage should be trimmed somewhat to reduce the leaf surface from which the water evaporates, causing wilting. The plants should be put in at the same depth that they grew previously, but, if grown very spindly, they may be placed a little deeper in the soil.

To get the best results, cultivation is necessary throughout the entire season. The riddance of weeds conserves the food and moisture for the plants, while the stirring of the soil produces a dust mulch which also tends to keep the moisture in the soil by reducing evaporation. To cultivate a small garden properly, such tools as a spade, a hoe, a rake, and a hand weeder are most essential, and a hand trowel and a dibble—a short, pointed stick—are necessary in transplanting. For a large garden a wheel-hoe makes a very convenient and labor-saving tool. Watering may be done with a hose, early in the morning or late in the afternoon, and it should be a thorough soaking of the ground, as a light sprinkling every evening does more harm than good.

The price of a good garden is a never-ceasing warfare against insect pests and plant diseases. There are a number of methods more or less successful in combating these pests —mechanical means, use of poisoned bait, fumigation, and spraying, the last being the most efficacious if the nature of the organism is known.

There are three classes of plant enemies that may be controlled by spraying—chewing insects, sucking insects, and plant diseases. The chewing insects bite off portions of the plant, chew and swallow them. Various caterpillars and some of the beetles belong to this class. The simplest manner of killing these is poisoning their food by coating it with a stomach poison like Paris green or arsenate of lead, but such poisons should be used only upon parts which are not for human consumption. White hellebore is useful for plants which are to be eaten shortly after spraying, because it loses its poisonous properties after a few days' exposure to the air. It may be dusted in dry form or mixed with water in the proportion of one pound to fifty gallons of water. Paris green may be used in powder form by dusting upon plants, or as a liquid by mixing six ounces with fifty gallons of water and six ounces of slaked lime to neutralize any soluble arsenic which may be present. Arsenate of lead is quite as poisonous as Paris green, but is more effective because of better sticking qualities. It comes either in paste or powder form, and is applied as a spray at the rate of two pounds to fifty gallons of water.

The sucking insects suck the juices out of the plants, and for that reason it is impossible to poison their food without injuring the plant itself. Plant lice are a common example of these insects. To eradicate them, a solution which kills by contact with their bodies is used, kerosene emulsion, whale-oil soap, and nicotine preparations being most commonly applied. The last named is the most effective and may be prepared in concentrated form and diluted as needed, generally using one ounce to a gallon of water.

Plant diseases are caused by the growth of parasitic plants, fungi, and bacteria within the tissues of the host. In order to prevent plant disease, the attack of these parasitic plants must be anticipated and the spray applied either before or just as the disease appears. The best material for this purpose is Bordeaux mixture, which consists of five pounds of copper sulphate, five pounds of lime, and fifty gallons of water. A prepared mixture ready for use may be procured at a seed store. Common examples of plant diseases are bean blight, celery rust, mildew on peas, leaf spot, etc. All spraying should be done with a hand sprayer or atomizer.

THE FALL GARDEN

The spring vegetable garden will furnish sufficient edible matter during the summer months, but it will not contain enough to store and prepare for winter use. In order to secure this winter supply a separate plot should be maintained where such crops as beans, beets, celery, cucumbers, potatoes, and tomatoes may be grown in large quantities. The table on page 66 indicates the quantity of seed and the yields for a twenty-foot row for all crops except potatoes, these being worthy of a special treatment. The early crop may be planted from March 15 to May 1, while the late crop may go in as late as June 1. However, it is advisable to plant even the late varieties before the extremely hot weather sets in, otherwise the yield will be affected materially. The potato "seed" consist of small sections of a potato tuber which contain at least two eyes. These are planted in rows 2½–3 feet apart, and 12 to 15 in the row, 2–4 inches deep, and immediately covered level with soil. One peck of potatoes is sufficient for planting 150 feet of rows, which should yield 3 bushels of potatoes. The best early varieties are Early Ohio, Early Rose, and Irish Cobbler, while Rural New Yorker No. 2 and Carman No. 3 are the best late varieties.

CANNING VEGETABLES

With a sufficient amount of land available, not only can fresh vegetables be raised for the summer's needs, but, perhaps what may prove to be even more important, a considerable addition to the winter's supply of food may be had at comparatively little extra cost and effort. As set forth in the preceding article, potatoes and similar crops which are easily stored should, when possible, constitute a part of the garden; but if this is not practicable, the canning of surplus vegetables, or, better, growing extra peas, corn, tomatoes, etc., especially for preserving, will help much towards preventing the anticipated food shortage in this country next fall and winter.

In America particularly we have become so accustomed to the preservation of all kinds of foods in glass or tin that it is difficult to realize how comparatively modern is this process. Yet it is less than a hundred years since the establishment of the industry, Ezra Daggett and Thomas Kensett being credited with packing oysters, lobsters, and salmon in New York, and William Underwood and Charles Mitchel preserving fruits in Boston, about 1820. Nicholas Appert, a French confectioner and chef, is usually regarded as the discoverer of the art of canning. The French government having offered a prize of 12,000 francs for a method of preserving foods which would be practicable for army and naval use, Appert set to work about 1795, but it was not until 1804 that he hit upon the essentials of the method, namely, heating the product and hermetically sealing the container. By 1810, after innumerable experiments, Appert was satisfied with the results and published his method, whereupon he was awarded the prize. Although primarily a war measure, the great advantage of being able to preserve food for indefinite periods was obviously of such value that the process was almost immediately applied commercially, and to-day the annual value of goods canned in the United States alone exceeds a quarter of a billion dollars.

Appert, of course, worked long before anything was definitely known concerning the causes of the spoiling of foods, and ascribed his results to the exclusion of the outside air. Indeed, Guy Lussac, one of the foremost chemists of his time, came to the same conclusion, reporting that decay was due to a series of oxidations and that Appert's method, by preventing contact with outside air, stopped the process. Similar explanations were made by other scientists, but not until the epoch-making investigations of Louis Pasteur was the fundamental principle discovered that all decay was due primarily to the activity of certain microscopic plants—the bacteria. However, the original means devised to exclude the air likewise excluded or destroyed the bacteria; consequently, the results were satisfactory, regardless of the specific cause of the trouble. It may be pointed out, however, that had Appert known the real source of the spoiling of foods it would not have required fifteen years for him to discover the remedy, and that the perfection of the canning industry has only been possible through the knowledge obtained from the science of bacteriology.

Successful canning depends, therefore, upon two things: first, the killing of all microörganisms within the can or jar of food, and, second, the sealing of the container so that no bacteria can enter from the outside. With the exception of a few fruits and vegetables which, upon standing, deteriorate in flavor and consequently are not worth preserving, the spoiling of canned foods is entirely due to the presence of bacteria. Either the method of killing the bacteria, commonly called sterilization, is inadequate, or, this being accomplished, bacteria from the outside are permitted to enter the can during or after sealing. Carelessness in closing the jar or can, whereby bacteria on the hands or a cloth or some utensil are communicated to the inside of the lid or jar, may result in the loss of the contents, even though the container be tightly closed afterwards. Of course, any hole or leak around the top of a jar, permitting the entrance of the decay-producing organisms, will likewise be disastrous—hence the use of the rubber ring on glass jars and of sealing wax, etc., for hermetically closing cans. Mere cleanliness, as the term is ordinarily used in the kitchen, is not sufficient for the preservation of food in containers. Absolute bacteriological cleanliness, the same that is necessary in the laboratory in the preparation of pure cultures of beneficial or disease-producing germs, must be maintained.

Fortunately, this is a comparatively simple matter, when one thoroughly understands the problem involved. While commercial canneries, because of the necessity of accomplishing the process on a large scale in a short space of time, are provided with elaborate and expensive apparatus, just as satisfactory results may be obtained by any householder with ordinary kitchen utensils. For sterilizing a number of jars at a time a wash boiler or certain types of ham boilers are admirably adapted. The wash boiler should be provided with a simple wire basket which will stand up from the bottom of the boiler about an inch. The basket should be strong enough to hold the weight of a dozen filled jars or cans, and it is usually necessary to strengthen the bottom with wooden strips or heavy wire or metal bands. Handles which will permit the full basket being lowered and lifted from the boiler are also a great convenience. If a wash boiler is not available, any sort of a vessel with a tight-fitting lid, large enough to contain one or more jars, may be used. In fact, it is well to have a small bucket fitted with a wire rack which will contain but a single jar, since with a small garden enough surplus vegetables for one jar may frequently be obtained, and it would be a waste of gas and labor to use a large sterilizer like a wash boiler for such a comparatively small operation.

Recipes for the preparation of the various vegetables are easily obtained from any good cook book, and there is no need of going into much detail here. Salt is usually added, and for some things, like asparagus, soaking in water containing lemon juice or vinegar is recommended. In general, all that is necessary is to clean and cut the raw vegetable into requisite size and pack into the jar, covering with cold water. Of course, the cleaner the jars and lids the better. If glass jars are used, the rubber ring should invariably be placed at this time and the lid put on loosely. About two or three inches of water is sufficient to put in the bottom of the boiler. More water takes more time and gas, and it is not the water which sterilizes, but the steam. After lowering the basket containing the jars into the boiler, and fitting on the lid of the boiler tightly, the water is brought to the boiling point and the contents subjected to the action of steam for one hour. If more jars are to be sterilized, remove the basket at the end of the hour, tighten the lids of the jars and set aside for 24 hours; or the boiler with its contents may be removed from the stove, and if the lid is tight the individual lids of the jars need not be tightened at this time. On the second day, repeat the process, being sure to loosen the lids previous to sterilization and tightening them afterwards, and set aside as before. After a second 24-hour period, sterilize again for the third and last time.

The reason for this so-called discontinuous sterilization or repetition of the steaming three times, after a considerable interval of cooling, is based upon a knowledge acquired from long bacteriological experimentation. While a single exposure to steam, with a temperature of approximately 212° F., will kill most of the bacteria ordinarily found on vegetables, certain germs are provided with cells or spores which will resist the action of even a greater heat. By setting aside for 24 hours, these spores grow into a stage which is more easily attacked by the heat and after the second cooling period and the third steaming, the last of these more resistant forms are killed.

Once all the bacteria within the jar are destroyed, it but remains to prevent the access of outside germs. This is accomplished by tightly closing or sealing the jar by the method provided. It is obvious that no matter how thoroughly the contents of the jar may be sterilized, if the rubber rings and tops are not applied until the end of the operation, germs from the air may be introduced which will render all the work done useless.

By the method above described, practically all vegetables grown in the garden may be preserved indefinitely. Peas, beans, beets, okra, squash, tomatoes, asparagus, and corn will all retain their characteristic flavor, and if the jars are kept in the dark there will be but little loss of color. If failure results, it will be due to a disregard of the directions given relative to the time of exposure to steam, or the number of sterilizations, or carelessness in finally sealing the jars. The term "jar" has been used throughout this article because glass containers are more easily cleaned and sealed, but with proper precautions the ordinary tin can may be used as well. Of course, the tin top should be on the can from the first. The type of jar with spring attachment instead of screw top has the advantage that after the final sterilization and cooling, before the jar is put away for the winter, the results of the treatment may be tested. After standing for two or three days, if the spring be released and the jar carefully picked up by the lid, the top will come off if sterilization has been incomplete. Bacteria within will have produced sufficient gas and consequent pressure to overcome the partial vacuum produced by the heating. In such cases it will probably be sufficient to sterilize once more, although in some cases if the directions given have been seriously neglected, so that the contents have obviously fermented, time will be saved by throwing away the contents and trying again.

The length of time for each steaming, namely, one hour, is designed for pint or quart jars only. Jars of larger capacity, because of the greater time necessary for the steam to thoroughly penetrate its contents, will require more time —approximately double the time for a two-quart jar and four times as long for a gallon jar.

It is hoped that this brief statement as to the fundamental principles involved in the preservation of vegetables, together with the simple means of accomplishing the desired result, will enable those having surplus products from their gardens to make the best possible use of them. While the three sterilizations may seem a needless repetition, wide experience has demonstrated that it is the only method of insuring perfect keeping, unless an expensive apparatus for applying steam under pressure can be resorted to. The extra time and labor involved will more than offset the loss which is almost certain to occur if less thorough methods are used.

NOTES

Mr. G. G. Hedgcock, of the United States Department of Agriculture, spent a day in the Garden herbarium recently.

Recent visitors to the Garden include Professor A. J. Carlson, of the University of Chicago, and Dr. G. F. W. Link, of the University of Nebraska.

The rare *Cypripedium Boltoni Sanderae,* a white-flowered type, has been donated to the Garden's orchid collection by Mr. D. S. Brown, of Kirkwood, Mo.

Mr. O. F. Cook, of the United States Department of Agriculture, spent a day at the Garden this last month consulting the herbarium in connection with his studies of economic plants.

On March 22, members of the faculty and students of the St. Louis College of Pharmacy visited the Garden. On behalf of the college there was presented to the Garden a collection of lantern slides representing taxonomic subjects.

On April 10, in the afternoon, Mr. Alexander Lurie, Horticulturist to the Garden, spoke on "Vegetables," before Butler Bros. Employes Association, and in the evening before the Richmond Heights School Patrons' Association.

Dr. George T. Moore, Director of the Garden, gave an illustrated lecture, March 27, on "Some New and Old Plant Industries," at the Washington University Medical School, under the auspices of the Washington University Association.

An illustrated lecture under the auspices of the St. Louis Art League was given in the graduate lecture room, April 9, by Dr. Wilhelm Miller, landscape architect of Chicago, on "Planning the Home Grounds and Beautifying City Thoroughfares."

On April 19 and 20, talks on "Vegetable Gardening" were given by Garden employes before the Boy Scouts at the following places: April 19, Knights of Columbus Hall, by Mr. W. W. Ohlweiler; April 20, St. Peter's Episcopal Church by Mr. G. H. Pring, Bryan Mullanphy School by Mr. Alexander Lurie, Kingshighway Presbyterian Church by Mr. Clarence Pedlow, and St. Peter's Evangelical Church by Mr. P. A. Kohl.

The following birds have been observed this year by the St. Louis Bird Club in the Missouri Botanical Garden:

April 15	April 22
Scaup-duck	Scaup-duck
	Coot
Wilson's Snipe	Wilson's Snipe
Bob-white	Bob-white
Screech Owl	
	Mourning Dove
Hairy Woodpecker	Hairy Woodpecker
Yellow-bellied Sapsucker	
	Chimney-swift
	Red-headed Woodpecker
Flicker	Flicker
Blue Jay	Blue Jay
Crow	Crow
Cowbird	Cowbird
Red-winged Blackbird	Red-winged Blackbird
Meadow-lark	Meadow-lark
Bronzed Grackle	Bronzed Grackle
	Goldfinch
White-throated Sparrow	White-throated Sparrow
Chipping Sparrow	Chipping Sparrow
Slate-colored Junco	
Song Sparrow	Song Sparrow
Fox Sparrow	
	Towhee
Cardinal	Cardinal
Cedar Waxwing	
	Purple Martin
	Warbling Vireo
	Yellow Warbler
Myrtle Warbler	Myrtle Warbler
	Catbird
Brown Thrasher	Brown Thrasher
	House Wren
Brown Creeper	Brown Creeper
Tufted Titmouse	Tufted Titmouse
Chickadee	
Golden-crowned Kinglet	
Ruby-crowned Kinglet	Ruby-crowned Kinglet
Hermit Thrush	
	Gray-cheeked Thrush
Robin	Robin

Bluebird	Bluebird
English Sparrow	English Sparrow
European Tree Sparrow	European Tree Sparrow

STATISTICAL INFORMATION FOR MARCH, 1917

Garden Attendance:	
Total number of visitors	12,189
Plant Accessions:	
Total number of plants and seeds donated	10
Plant Distribution:	
Plants distributed in exchange	110
Library Accessions:	
Total number of books and pamphlets bought	78
Total number of books and pamphlets donated	200
Herbarium Accessions:	
By Purchase —	
E. Bartholomew—"Fungi Columbiani," Cent. XLIX, L, and LI, Nos. 4801–5100	300
D. L. Crawford—Plants of Nicaragua, collected by C. F. Baker in 1903	217
A. J. Grout—"North American Musci Pleurocarpi," Nos. 457–475	26
By Exchange —	
Ira W. Clokey—Plants of Texas, collected by Mr. and Mrs. J. Clemens in 1911	485
By Gift —	
Miss Florence Beckwith—Plants of Illinois, Missouri, and Kansas	87
J. A. Drushel—Plants of the United States	11
E. J. Durand—*Sebacina incrustans* on living violets from New York	1
L. O. Overholts—Co-types of *Clitocybe coloradensis* Murr. and *C. Overholtsii* Murr., also fungi from Pennsylvania	9
Forrest Shreve—Plants of Arizona	28
H. Schmitz—*Atriplex hymenelytra* (Torr.) Wats., "Desert Holly" from California	1
P. Wilson—Fungi from vicinity of New York City	68
TOTAL	1,233

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

BENJAMIN MINGE DUGGAR,
Physiologist in charge of Graduate Laboratory.

HERMANN VON SCHRENK,
Pathologist.

JESSE M. GREENMAN,
Curator of the Herbarium.

EDWARD A. BURT,
Mycologist and Librarian.

J. C. TH. UPHOF,
Assistant Botanist.

GEORGE W. FREIBERG,
Research Assistant.

KATHERINE H. LEIGH,
Secretary to the Director.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

JOHN NOYES,
Landscape Designer.

ALEXANDER LURIE,
Horticulturist.

A. B. McINTYRE,
Outdoor Gardens.

J. J. COUGHLIN,
Construction.

P. FOERSTER,
Farm and Stables.

W. F. LANGAN,
Engineer.

G. H. PRING,
Conservatories.

M. SCHILLER,
Floral Displays.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. V MAY, 1917 No. 5

MISSOVRI BOTANICAL GARDEN
1889

CONTENTS

Page
Storage of Vegetables - - - - - - - 81
Seed for 1918 - - - - - - - - - 84
Notes - - - - - - - - - - - 86
Statistical Information - - - - - - - 90

ST. LOUIS, MO.
1917
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

EDWARD C. ELIOT.

GEORGE C. HITCHCOCK.

P. CHOUTEAU MAFFITT.

EDWARD MALLINCKRODT.

LEONARD MATTHEWS.

WILLIAM H. H. PETTUS.

PHILIP C. SCANLAN.

JOHN F. SHEPLEY.

EX-OFFICIO MEMBERS

EDMUND A. ENGLER,
President of The Academy of Science of St. Louis.

FREDERIC A. HALL,
Chancellor of Washington University.

HENRY W. KIEL,
Mayor of the City of St. Louis.

BENJAMIN P. STROMBERG,
President of the Board of Public Schools of St. Louis.

DANIEL S. TUTTLE,
Bishop of the Diocese of Missouri.

ROLAND W. SWITZER, Secretary.

Missouri Botanical Garden Bulletin

Vol. V St. Louis, Mo., May, 1917 No. 5

STORAGE OF VEGETABLES

One of the problems confronting the amateur gardener in the fall will be the storage of vegetables for winter use. To be stored successfully vegetable crops should be planted at such a time as to be properly developed at the time of storage. Most of the crops usually keep best if stored comparatively late, so that it should be the aim of the gardener to mature the plants as late as possible and yet not to have them injured by cold. If planted too early root crops are likely to become tough and undesirable, while cabbages are liable to split. Onions, parsnips, salsify, horse-radish, etc. may be planted as soon as the ground is ready in the spring, potatoes, beets, and carrots about May 15, and cabbage, celery, and turnips about July 1.

Three important factors should be taken into account when providing storage facilities—moisture, temperature, and fresh air. No general rule can be formulated to apply to all classes of vegetables, as different crops require various combinations of conditions. Root crops, for instance, should be kept quite moist in order to preserve their plumpness and succulence, while onions, squashes, and sweet potatoes should be kept dry to avoid decay. With a few exceptions 2–5° above freezing is the most favorable temperature for safe storage. Air circulation is absolutely essential for onions, but root crops do better when not in contact with fresh air. Vegetables which are expected to continue growth in storage, such as celery, leeks, Brussels sprouts, etc., should be planted in soil and the roots kept moist, while free circulation and low temperature are required. On the other hand, squashes demand a high temperature and dry atmosphere.

The cellar of a residence is often used to preserve vegetables, but as a rule it provides unsatisfactory conditions, especially if it contains a furnace which makes the air warm and dry. This difficulty may be overcome by partitioning off part of the space with any material which will keep out the heat and by providing ample ventilation by means of windows on the sunny side of the house. Air circulation may be secured by running a 3-inch tile under the floor with an opening into the storage cellar and 30–40 feet away from the house. The fresh air is brought under the floor and coming through is distributed over the bottom, and the warm air is taken care of through the windows.

If the cellar does not provide sufficient room or is not suitable for the storage of certain vegetables the method of burying in pits is used. A shallow pit should be dug in which the vegetables are placed, covered with straw and soil, and later overlaid with manure to prevent freezing and boards to shed the rain. To avoid overheating it is desirable in some cases (cabbage) to cover lightly at first and later to add the dressing heavier.

Cold-frames may also be used to advantage in storing vegetables, providing the drainage is made thorough. After the frames are filled the sash should be covered with boards and the outside banked with soil or manure. As the weather becomes severe a covering of straw or mats will be necessary.

Beans should be stored in a dry place, regardless of the cold, as they are not injured by freezing.

Cabbages may be stored in the cellar by packing in boxes or barrels filled with soil or sand. For winter use, however, they will keep better in an outdoor pit. The pit need not be more than 2 feet deep and wide enough to accommodate 3 or 4 heads placed in a row. If the soil is not well drained the heads should be laid on the surface of the ground, leaving the outer leaves and roots on. In either case the heads should be placed with roots up in 2 layers—3 in the first and 2 in the second. The mound should then be covered with a layer of straw 6–8 inches deep. As the weather becomes colder 6–8 inches of soil should be added, and finally a coating of manure to prevent freezing. At the bottom of the pile an opening should be left for removal of material, this being stuffed with straw when not in use.

Cauliflower which fails to mature in the fall may be taken up and planted in shallow boxes of soil in the lightest part of the cellar and kept well watered. The crop will then gradually mature for winter use.

Celery may be stored in a number of ways, but the most satisfactory method for home use is to take up the plants and plant the roots in boxes of soil. By keeping the roots supplied with moisture, giving plenty of air at the tops, and a temperature of 35° F., celery will keep in good condition throughout the winter. The moisture should be supplied through holes bored about 4 inches from the bottom of the box, so as not to wet the foliage. Sphagnum moss or sand may be substituted for soil.

Onions require a dry cool atmosphere. They should be thoroughly cured, dried, and all the tops cut off before storing. Market baskets, trays, or any other receptacle which will permit of proper air circulation may be used as containers. If the bulbs begin to grow in the spring a good crop of green onions can be secured by setting them outdoors in beds.

Parsnips, salsify, and horse-radish, not being injured by frost, may be placed in a pile on the ground and covered with 6 inches of soil. The advantage of storing in this manner instead of allowing the roots to remain in the soil is the saving of the time and inconvenience of digging in frozen ground. If desired to store in the cellar the roots should be covered with moist sand, leaves, or soil, and kept as near the freezing point as possible.

Potatoes should be stored in a cool frostless cellar in long narrow bins divided into sections to hold about 2–3 bushels. A covering of sand or soil is beneficial to keep moisture in. The tubers should be dug on a bright day when the soil is dry so that it will shake off readily. They should not be washed nor exposed to light for any length of time after harvesting, as that will cause them to turn green. If tubers begin sprouting in the spring all the shoots should be rubbed off. The bins should be examined occasionally and any rotting tubers removed to prevent the spread of infection. Potatoes may also be stored outdoors by placing in a conical pile and covering with 6–8 inches of straw, 6–8 inches of soil, and a layer of manure. A ventilator made of boards 4 inches wide should be placed at the apex running down to the tubers. When freezing weather sets in it should be stuffed with fine hay.

The root crops—beets, carrots, turnips, etc.—should be kept cool in a cellar and packed in damp soil or sand. It is desirable to leave on part of the tops for convenience in use and conservation of flavor. The better means of storage is the pit method similar to the one recommended for potatoes. In getting the vegetables from pits in midwinter the manure is removed at the base of the pile and a hole 1 foot square is chopped through the frozen soil. Sufficient straw is pulled out to enable one to thrust an arm into the opening. The hole should then be stuffed again.

Squashes and sweet potatoes are susceptible to cold and moisture, and for that reason should be stored in a dry place where the temperature will approximate 50° F. Squashes may be kept by piling on a dry floor and covering with rugs or carpets, but care must be taken that they do not become bruised before storing. Sweet potatoes may be packed in layers in dry sand, wheat chaff, or charcoal, and kept in a warm cellar.

Tomatoes may be saved for winter use not only by canning but also by storing. They should be picked as they begin to turn, leaving the stems on and taking care not to bruise them. The fruits should be packed in a barrel or box in clean dry sand, being placed some distance apart and kept in a dry cool cellar. Fruits which fail to ripen before frost may be taken indoors and ripened, or ripening upon vines may be hastened a week or 10 days by bagging the fruit.

SEED FOR 1918

The selection and saving of seed should ordinarily be left to the specialist whose knowledge and working conditions enable him to produce the best stock at the least expense and effort. However, on account of the threatened scarcity of supply, it may be desirable for the amateur gardener to grow and save the seed for next year's crop.

It is of course essential that the plants which are to be saved for seed should receive the best of care and should grow under conditions favoring the most perfect development of fruits. It often happens that a very poor plant produces one or two very superior fruits, but it would be found that the characters of the entire plant are more likely to be perpetuated than those of individual fruits. Thus, a plant producing a large quantity of uniform-sized tomatoes is better to select from than one which has one branch bearing very large fruit, while the other branches have small fruit or none at all; also, small potatoes from a productive hill give better results than large ones from unproductive hills. A common mistake is made in harvesting the entire crop and then selecting at hazard from it.

Seeds should not be harvested until fully ripe but the harvesting should start promptly to avoid discoloration. Seeds are ripe when the seed receptacles become yellow or the fruits attain full coloration and begin to lose firmness. Seeds that require threshing, like beans or peas, should be harvested during bright sunny weather. The fleshy fruits should first be mashed to get rid of all superfluous water. The pulp with seeds is then thrown into a receptacle containing water, where it remains in a state of fermentation for 2 or 3 days, this being necessary to loosen the mucilaginous coat from the seeds. After fermentation the seed are separated by successive washings, the good heavy seed falling to the bottom of the receptacle, while the skin, pulp, and light seed float on the top. The good seeds should then be spread in thin layers upon sheets and allowed to lie in the sun until thoroughly dried and cured, which usually takes 3–4 days in bright sunny weather. They should then be stored in cloth or paper sacks and placed in a dry atmosphere with plenty of air circulation.

Beans are harvested by pulling the vines up when the seed are ripe and stacking them around poles 4–5 feet high to cure for 4–5 days. As soon as the vines are thoroughly dried they are taken to a storage place and threshed by means of flails or special machinery when in large quantities. After threshing the seed should be sorted and all that is small or diseased thrown aside. Lima beans are harvested in a similar manner but are left to cure longer in the field.

The value of seed corn is largely dependent on the way it is gathered and cured. The crop should be harvested as soon as the grain has fully passed into the dough or milk state. The cut stalks should be put into shocks for 4 or 5 days, after which the ears may be husked and placed in drying cribs. In curing corn it is essential that every ear be exposed to circulating air until all grain is perfectly dry and that the temperature be kept above 36° F., as the vitality of green corn is considerably lessened by exposure to cold weather. The ears may be placed on slats laid upon scaffolds in a barn or any other airy warm place. Another method is to use sticks 1–2 inches wide and 4 feet long in which nails have been driven at uniform distances, the ears of corn being stuck upon these nails and the entire stick hung up. Corn keeps best when left on the cob until ready for use and is not injured by cold weather once it is thoroughly dried.

For production of onion seed on a small scale mature bulbs should be selected and planted early in the spring, 4–5 inches deep, 6 inches apart, and 18 inches between rows. After the seed stalks are well started the soil should be hilled around the plants to provide support. This is done several times a season, finally leaving a ridge 8 inches high. Promptness is important, because if delayed, the seed receptacles burst open, shedding the seed. When the tops become yellow they should be removed with 5–6 inches of stem and stored in well-ventilated rooms until dry enough for threshing. As the entire crop does not mature at the same time several cuttings are necessary. Cleaning is done by repeated winnowing and by washing in buckets to separate the light seed and chaff. The seed should be thoroughly dried and stored in a dry place.

If the seeds are not properly cured or not stored under suitable conditions or if kept too long before sowing they may fail to germinate. To be certain of the viability of the seed it is essential that a germination test be made. One of the best ways of making this test is to plant 100 seeds in a flower pot or flat of soil, counting the seedlings as they appear to ascertain the percentage of germination. Another way is to place the seeds in moist sand between 2 plates, or instead of sand, 2 moist blotters may be used. By still another method the seed are laid out on a piece of moist flannel and the whole carefully rolled up. Whatever the method used it is necessary to keep the medium moist and warm and also to keep the seeds far enough apart to prevent the spreading of any mould which might form.

PERCENTAGE OF SEED GERMINATION

Asparagus	85 per cent	Lettuce	95 per cent
Bean	95 per cent	Melon	90 per cent
Beet	150 per cent*	Okra	80 per cent
Cabbage	95 per cent	Onion	85 per cent
Carrot	85 per cent	Parsley	70 per cent
Cauliflower	85 per cent	Parsnip	75 per cent
Celery	65 per cent	Pea	98 per cent
Corn	85 per cent	Radish	95 per cent
Cucumber	90 per cent	Squash	90 per cent
Egg-plant	80 per cent	Tomato	90 per cent
Endive	85 per cent	Turnip	95 per cent

* Each beet seed is really a fruit containing 2–7 seeds.

NOTES

Volume IV, Number 2, of the Annals of the Missouri Botanical Garden has been issued with the following contents:

"Studies in the Physiology of the Fungi. III. Physical Properties of Wood in Relation to Decay Induced by Lenzites saepiaria Fries." S. M. Zeller.

"Studies in the Physiology of the Fungi. IV. The Growth of Certain Fungi in Plant Decoctions." B. M. Duggar, J. W. Severy, and H. Schmitz.

"Studies in the Mosaic Diseases of Plants." G. W. Freiberg.

Mr. John Noyes, Landscape Designer to the Garden, attended the National Conference on City Planning at Kansas City, May 7–9.

On May 10 Dr. George T. Moore, Director of the Garden, spoke before the McKinley High School on "Some Applied Aspects of Botany."

The Annual Flower Sermon, provided for in Mr. Shaw's will, was preached at Christ Church Cathedral on Sunday, May 13, by Rev. James E. Freeman, of St. Mark's Church, Minneapolis.

On April 25 Mr. Alexander Lurie and Mr. John Noyes, respectively Horticulturist and Landscape Designer to the Garden, acted as judges of Webster Groves flower gardens under the auspices of the Webster Groves Garden Club.

Mr. C. L. Moody, a graduate of the University of Maine, has succeeded Mr. Max Geisler, in charge of trees and shrubs at the Garden. Mr. Geisler has been appointed research assistant with the Forest Service at the Utah Experiment Station.

The following lectures have been given by Mr. Alexander Lurie, Horticulturist to the Garden: "Flower Gardens" before the Rose Fanning School, April 20; "Questions on Vegetables" at the Kirkwood City Hall, May 4, and at Webster Groves, May 14.

During the past few weeks members of the scientific and Garden staffs and Garden students have given assistance to the Women's Central Committee on Food Conservation by testing soils, making demonstrations, and giving talks on planning and planting a vegetable garden.

On May 5 several delegates to the National Conference on City Planning at Kansas City visited the Garden, among whom were Mr. Nelson P. Lewis, Chief Engineer, Board of Estimate and Apportionment, New York City; Mr. Thomas Adams, Town Planning Adviser, Commission of Conservation, Canada, and Mr. Richard B. Watrous, Secretary, American Civic Association, Washington, D. C.

Prof. Charles M. Robinson and several students in city planning from the University of Illinois, accompanied by Mr. Harland Bartholomew, Engineer for the City Plan Commission, visited the Garden, April 29. Other recent visitors include Dr. B. O. Dodge and Dr. Brown, of Columbia University, who are engaged this summer in plant disease survey work for the Bureau of Plant Industry, and Dr. C. T. Gregory, on leave of absence from Cornell University, who spent a day at the Garden collecting information for the Bureau of Plant Industry regarding cereal diseases.

The St. Louis Association of Gardeners at its regular meeting unanimously adopted the following resolution in regard to the conservation of the native flora of St. Louis and County:

> "Our native flora, owing to indiscriminate collectors, is rapidly becoming in danger, especially in the proximity of St. Louis. The frequent picnic parties, etc., visiting the country for Sunday vacations, unfortunately become enthusiastic with native flowering plants to such an extent that they devastate the landscape of its beauty, with the idea of reproducing the effect in the city garden. In the majority of cases the amateur does not study the environmental factors, the result being a total loss.
>
> "The Association therefore recommends to the people of St. Louis that the woodland flowers should remain unmolested in their natural environments, allowing their beauty to be admired by all.
>
> "A copy of this resolution is being sent to all garden clubs, horticultural societies, and florists' clubs of St. Louis.
>
> Respectfully submitted,
> G. H. Pring,
> *Publicity Secretary.*"

The following birds have been observed in the Missouri Botanical Garden by Messrs. Daniels, O'Neal, and Tatum, of the St. Louis Bird Club:

April 29	May 12 and 13
Wild Goose	
Green Heron	
Black-crowned Night Heron	
Wilson's Snipe	
Solitary Sandpiper	Solitary Sandpiper
	Spotted Sandpiper
Bob-white	Bob-white
Screech Owl	
Mourning Dove	Mourning Dove
Belted Kingfisher	
Hairy Woodpecker	Hairy Woodpecker
Red-headed Woodpecker	Red-headed Woodpecker
Flicker	Flicker
Night Hawk	
Chimney-swift	Chimney-swift
Ruby-throated Humming-bird	Ruby-throated Humming-bird
	Kingbird
Crested Flycatcher	Crested Flycatcher
Blue Jay	Blue Jay
Crow	Crow
Cowbird	Cowbird
Red-winged Blackbird	Red-winged Blackbird
Meadow-lark	Meadow-lark
	Orchard Oriole
Baltimore Oriole	Baltimore Oriole

Bronzed Grackle	Bronzed Grackle
Purple Finch	Purple Finch
Goldfinch	Goldfinch
White-throated Sparrow	White-throated Sparrow
Chipping Sparrow	Chipping Sparrow
Field Sparrow	
Song Sparrow	Song Sparrow
Swamp Sparrow	
Towhee	Towhee
Cardinal	Cardinal
	Rose-breasted Grosbeak
	Indigo Bunting
Purple Martin	
Barn Swallow	
Tree Swallow	Tree Swallow
Bank Swallow	Bank Swallow
Rough-winged Swallow	
	Migrant Shrike
Warbling Vireo	Warbling Vireo
	Bell's Vireo
Yellow Warbler	Yellow Warbler
Myrtle Warbler	
Palm Warbler	
	Magnolia Warbler
	Water Thrush
Maryland Yellow-throat	Maryland Yellow-throat
Mocking-bird	
	American Redstart
Catbird	Catbird
Brown Thrasher	Brown Thrasher
Carolina Wren	
House Wren	House Wren
Red-breasted Nuthatch	
	White-breasted Nuthatch
Tufted Titmouse	Tufted Titmouse
Ruby-crowned Kinglet	Ruby-crowned Kinglet
Wood Thrush	Wood Thrush
Gray-cheeked Thrush	
Olive-backed Thrush	Olive-backed Thrush
Hermit Thrush	
Robin	Robin
Bluebird	Bluebird
English Sparrow	English Sparrow
European Sparrow	European Sparrow

STATISTICAL INFORMATION FOR APRIL, 1917

GARDEN ATTENDANCE:

Total number of visitors	23,418

PLANT ACCESSIONS:

Total number of plants donated	24
Total number of plants received in exchange	105

PLANT DISTRIBUTION:

Total number of plants distributed in exchange	17

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	123
Total number of books and pamphlets donated	82

HERBARIUM ACCESSIONS:

By Purchase —	
E. Bartholomew — "North American Uredinales," Cent. XVII, Nos. 1601–1700	100
B. F. Bush — Plants of Missouri	211
J. B. S. Norton — Plants of Maryland	25
Chas. T. Vorhies — Plants of Arizona	117
By Exchange —	
Ira W. Clokey — Plants of Utah, California, Nevada, and Mexico, collected by Mr. Marcus E. Jones in 1882, including several types	690
By Gift —	
B. F. Bush — *Gyromitra caroliniana* and *Morchella gigas* from Missouri	2
Dr. W. G. Farlow — *Aleurodiscus* on cultivated grape vine	1
Prof. H. T. Fitzpatrick — *Hymenochaete tabacina* from Brookton, N. Y.	1
L. O. Matthews — Plants of the Orient, Arabia, Egypt, the Holy Land, etc.	44
Dr. Lars Romell — Thelephoraceae of Malme Expedition, South America	4
Dr. Lars Romell — Thelephoraceae of Sweden	2
Dr. J. B. Rorer — Museum specimen of 2-year-old Cacao tree fatally infected with the "pink disease" fungus, *Corticium salmonicolor*	1
Dr. J. A. Stevenson — Fungi of Porto Rico	11
Dr. J. R. Wier — Specimens of *Merulius* from Idaho	7
	1,216

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

BENJAMIN MINGE DUGGAR,
Physiologist in charge of Graduate Laboratory.

HERMANN VON SCHRENK,
Pathologist.

JESSE M. GREENMAN,
Curator of the Herbarium.

EDWARD A. BURT,
Mycologist and Librarian.

J. C. TH. UPHOF,
Assistant Botanist.

KATHERINE H. LEIGH,
Secretary to the Director.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

JOHN NOYES,
Landscape Designer.

ALEXANDER LURIE,
Horticulturist.

A. B. MCINTYRE,
Outdoor Gardens.

J. J. COUGHLIN,
Construction.

P. FOERSTER,
Farm and Stables.

W. F. LANGAN,
Engineer.

G. H. PRING,
Conservatories.

M. SCHILLER,
Floral Displays.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. V JUNE, 1917 No. 6

MISSOVRI BOTANICAL GARDEN
1889

CONTENTS

Page
Tree Surgery - - - - - - - - 91
Plants in the Cycad House - - - - - 97
Notes - - - - - - - - - - 103
Statistical Information - - - - - - 106

ST. LOUIS, MO.
1917
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

BOARD OF TRUSTEES OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

Edward C. Eliot.	**Leonard Matthews.**
George C. Hitchcock.	**William H. H. Pettus.**
P. Chouteau Maffitt.	**Philip C. Scanlan.**
Edward Mallinckrodt.	**John F. Shepley.**

***EX-OFFICIO* MEMBERS**

Edmund A. Engler,
President of The Academy of Science of St. Louis.

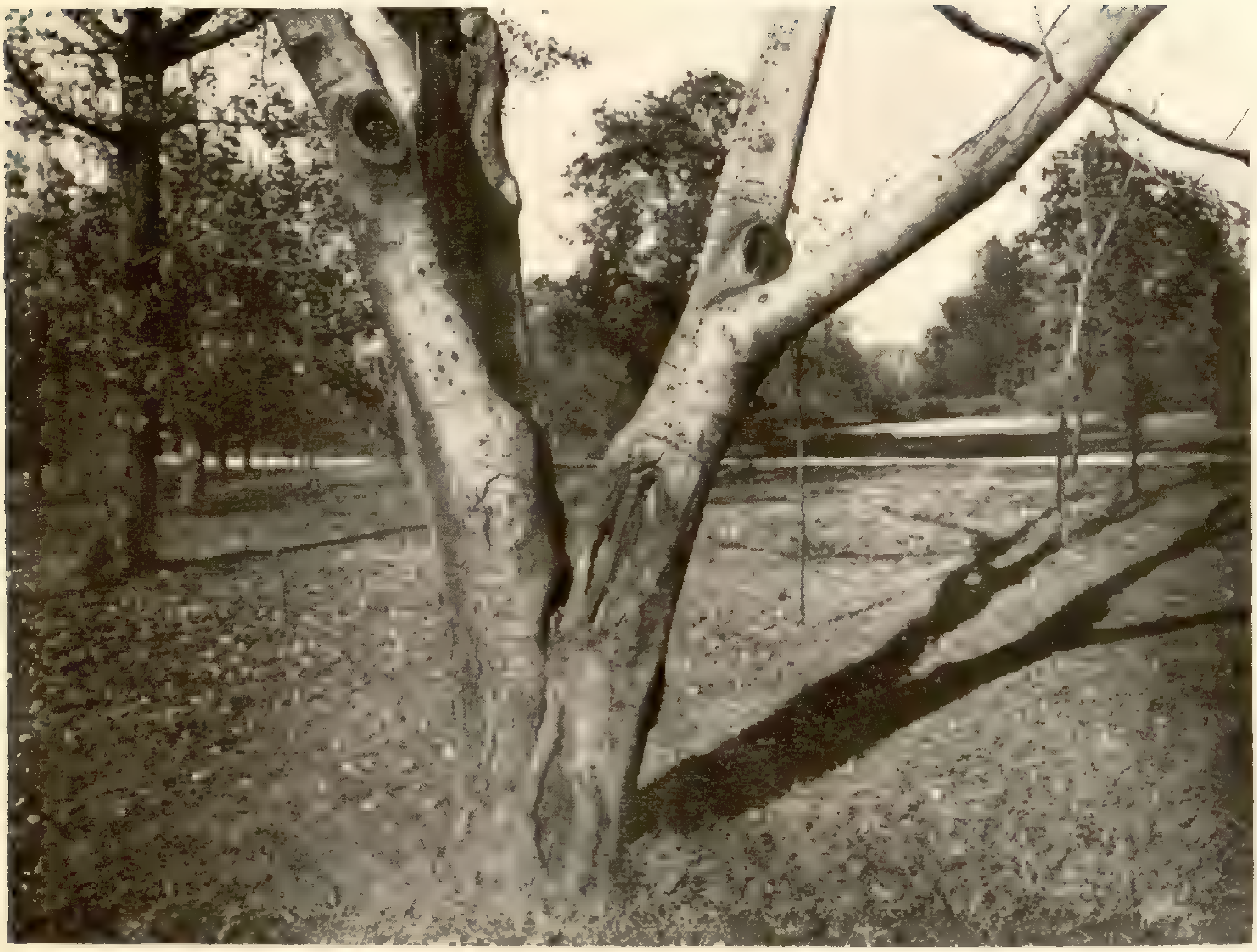
Henry W. Kiel,
Mayor of the City of St. Louis.

Frederic A. Hall,
Chancellor of Washington University.

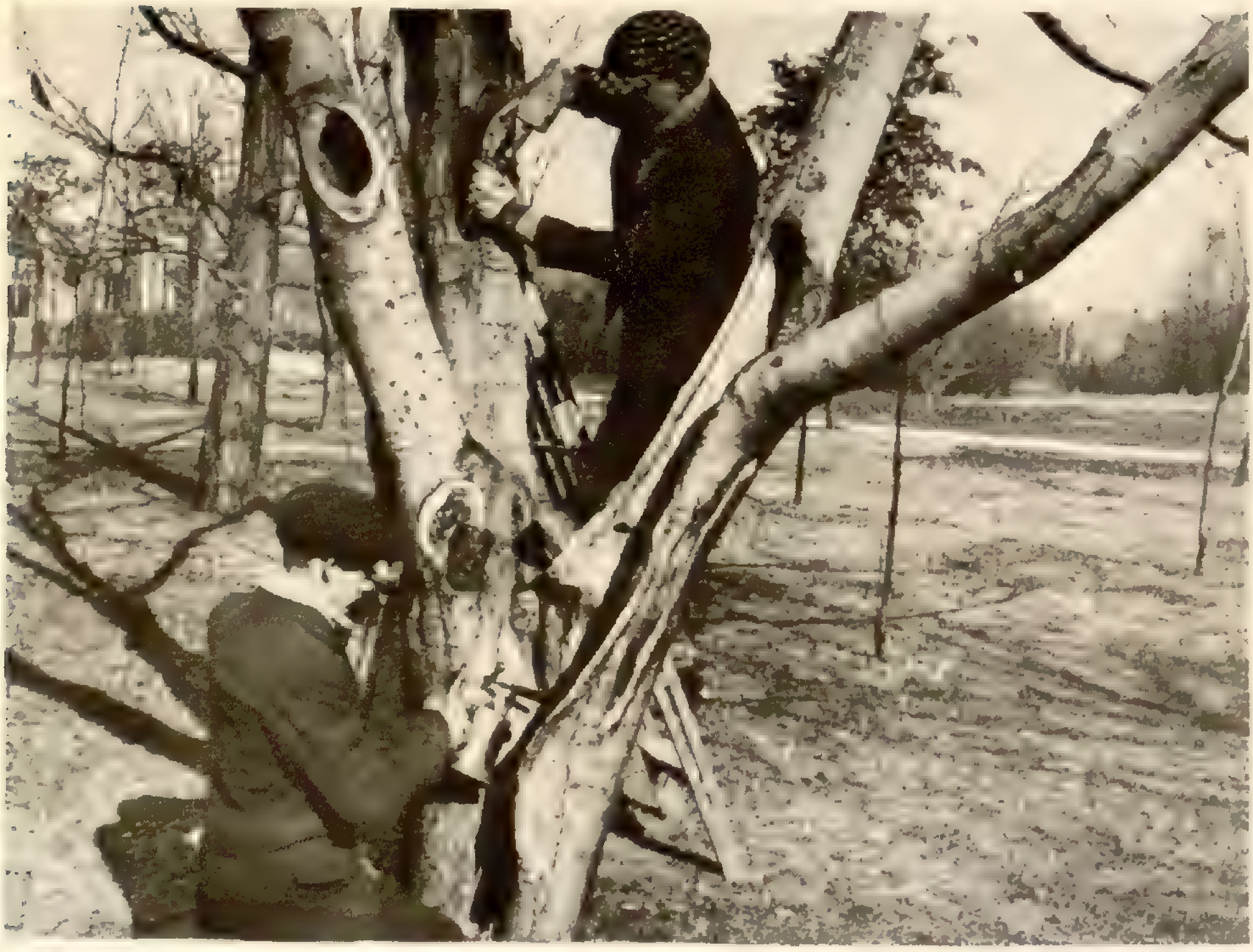
Benjamin P. Stromberg,
President of the Board of Public Schools of St. Louis.

Daniel S. Tuttle,
Bishop of the Diocese of Missouri.

Roland W. Switzer, Secretary.



TREE IN NEED OF REPAIR.



EXCAVATING AND BURNING OUT WITH TORCH.

Missouri Botanical Garden Bulletin

Vol. V St. Louis, Mo., June, 1917 No. 6

TREE SURGERY

Tree surgery is rapidly gaining in importance and popularity, as people are beginning to appreciate the value of preserving their trees. However, there would be very little need for it if trees were properly planted, well nourished, and cared for during their lifetime. It is seldom realized that trees need fertilization as well as other plants, and the stronger and more vigorous the tree the greater will be its power of resistance to entrance of insects and disease. Maltreatment of trees is common, nails being driven into the bark, wire girdled around the trunk, bark scraped and scarred by lawn mowers, and limbs broken off, and it is the object of tree surgery to remedy the damage done by such conditions. Its popularity is due to the spectacular effects achieved and the influence of "tree doctors" who shroud the work in mystery and foster the impression that a certain inner communion is necessary between them and the tree to attain successful results. The operations, however, are simple if tree structure, nature of decay, and principles of treatment are thoroughly understood.

The trunk of the tree serves the functions of supporting the foliage and acting as circulation medium between the roots and the leaves. The roots absorb moisture and mineral constituents from the soil, which pass through the trunk up to the leaves in crude liquid form. Through the agency of the green chlorophyll particles in the leaves this crude sap is converted into sugar and starch, and is then disseminated through all the portions of the tree as the digested sap which is responsible for the nourishment and consequent growth. The cross-section of the trunk, fig. A, shows four separate concentric portions: the heartwood in the center, next the sapwood, then a very thin layer of cambium, and on the outside the bark. The most important layer from the standpoint of tree surgery is the cambium. It is the growing part, healing wounds, covering cavities, and each year laying a thin layer of cells over the entire surface of the tree. It is the cambium also that conveys all the digested sap through the tree. Next in importance is the sapwood which carries the crude sap up to the leaves, and during winter, together with the roots, acts as a storage house for the dormant food. The heartwood functions as the supporting tissue, although it may help convey some crude sap. The bark is the protective covering for the cambium layer and thus indirectly plays a very important rôle in the life of the tree.

If a broken limb is cut off close to the trunk, the resulting wound is oval, and plate 10, fig. 2, shows how the healing will take place. As the exposed cambium offers less resistance to the flow of digested sap, it is accelerated, forcing rapid growth of cells which gradually cover the wounded surface by rolling over it. It is generally found that the cut heals most rapidly along the sides, less so at the top, and least of all at the base. This is explained by the fact that sap tends to flow in fairly straight lines, hence the greatest flow and growth are past the sides. For this reason, the narrow wound will heal more rapidly than one square or oval running perpendicular to the trunk.

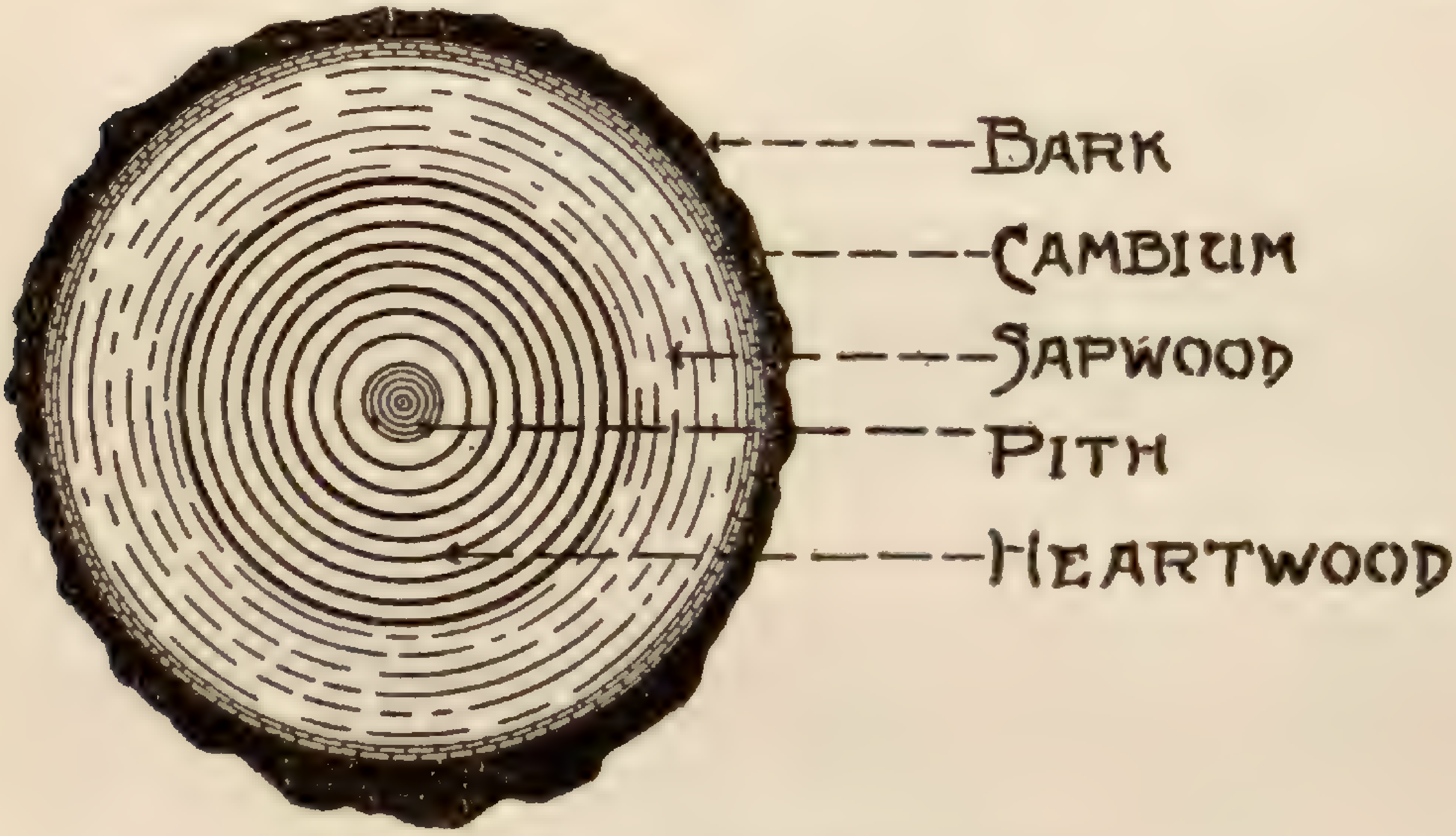
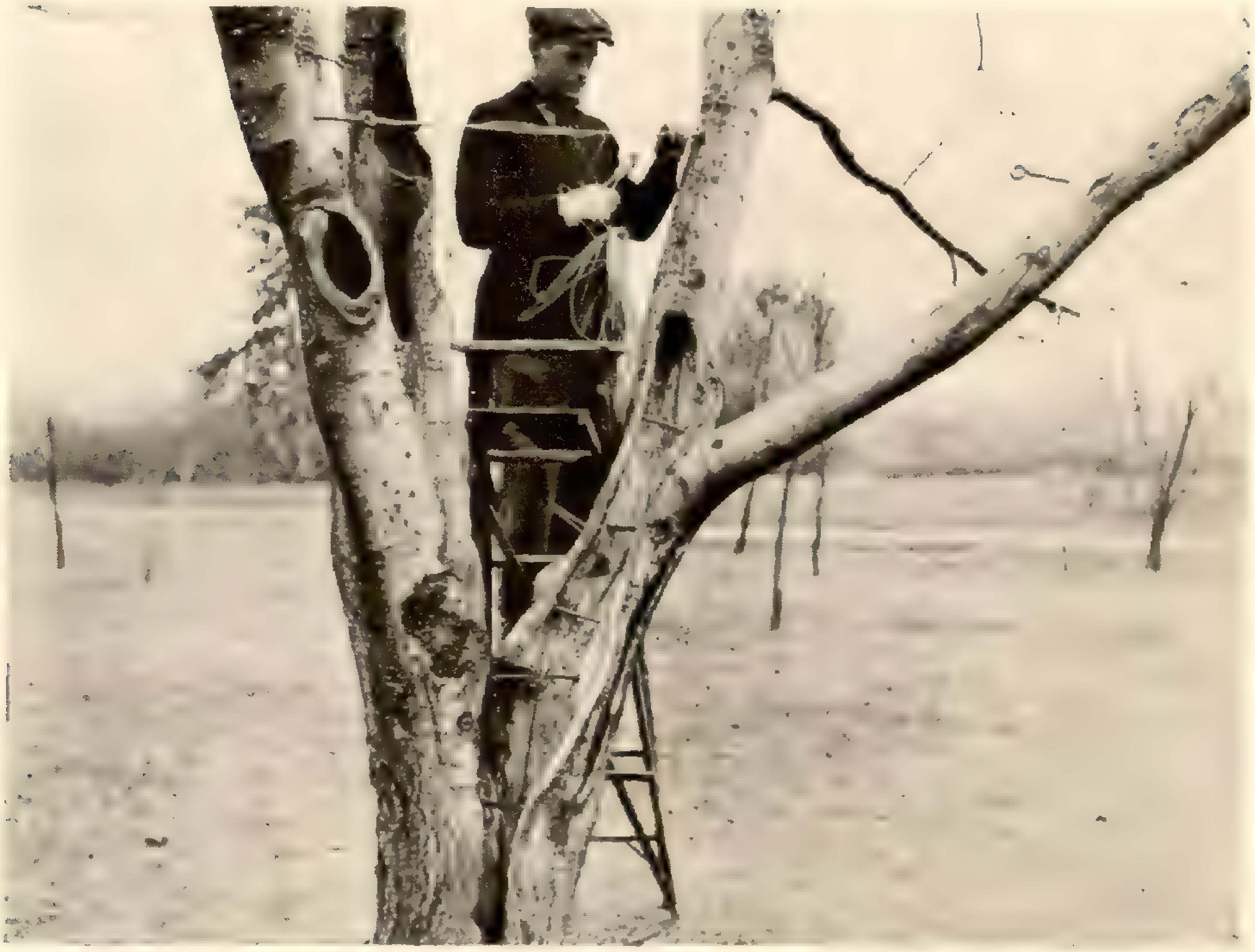
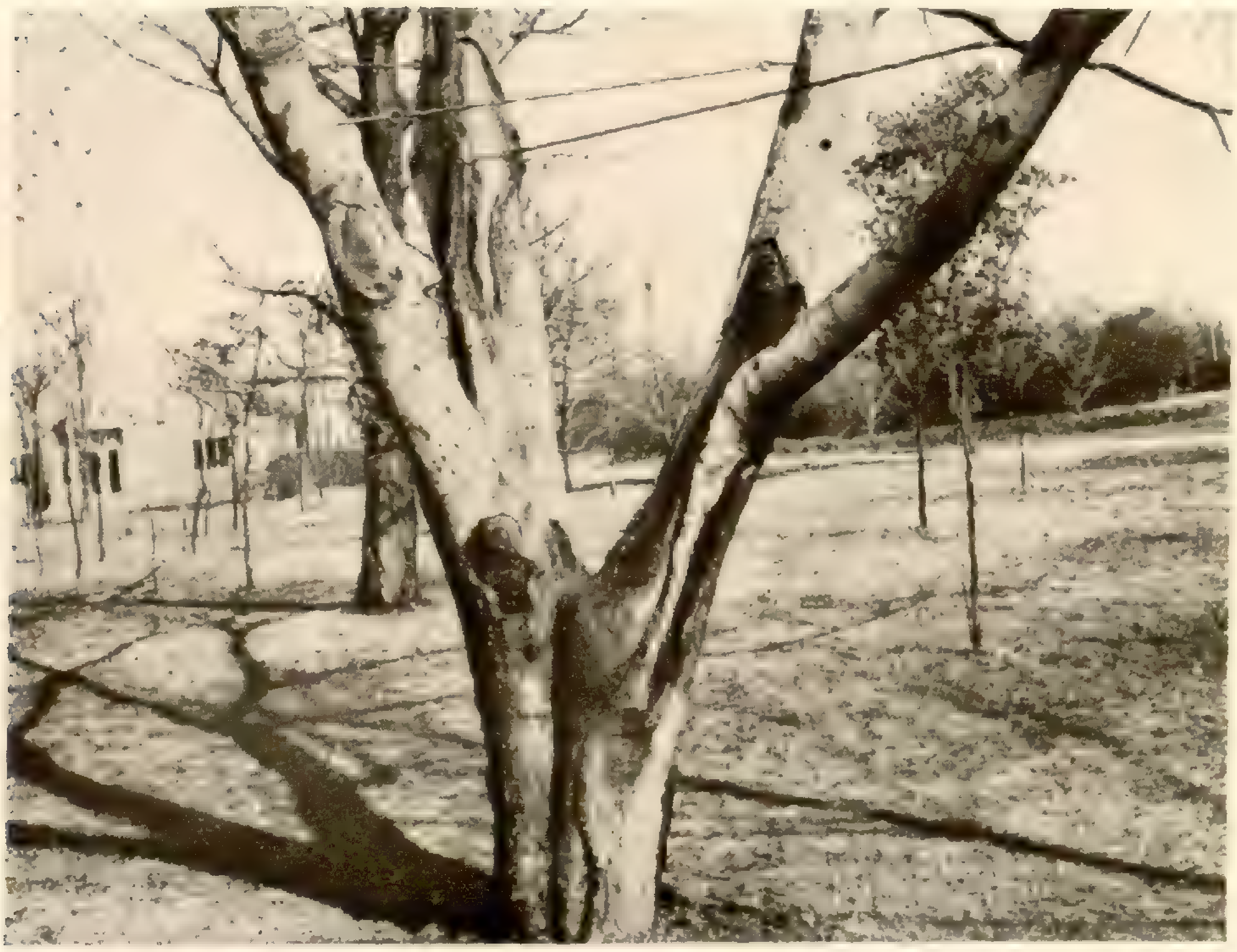


Fig. A. Cross-section of tree trunk.

Proper treatment of wounds implies prevention of entrance of fungi and insects and facilitation of healing. In order to prevent the entrance of enemies some protective dressing must be applied. The dressings are divided into two classes: those that disinfect or preserve the wood, killing the spores of the fungi and eggs of insects, and those



BOLTED AND BRACED.



FILLED WITH CONCRETE AND PAINTED.

that fill the wood making it impervious to entrance of parasites.

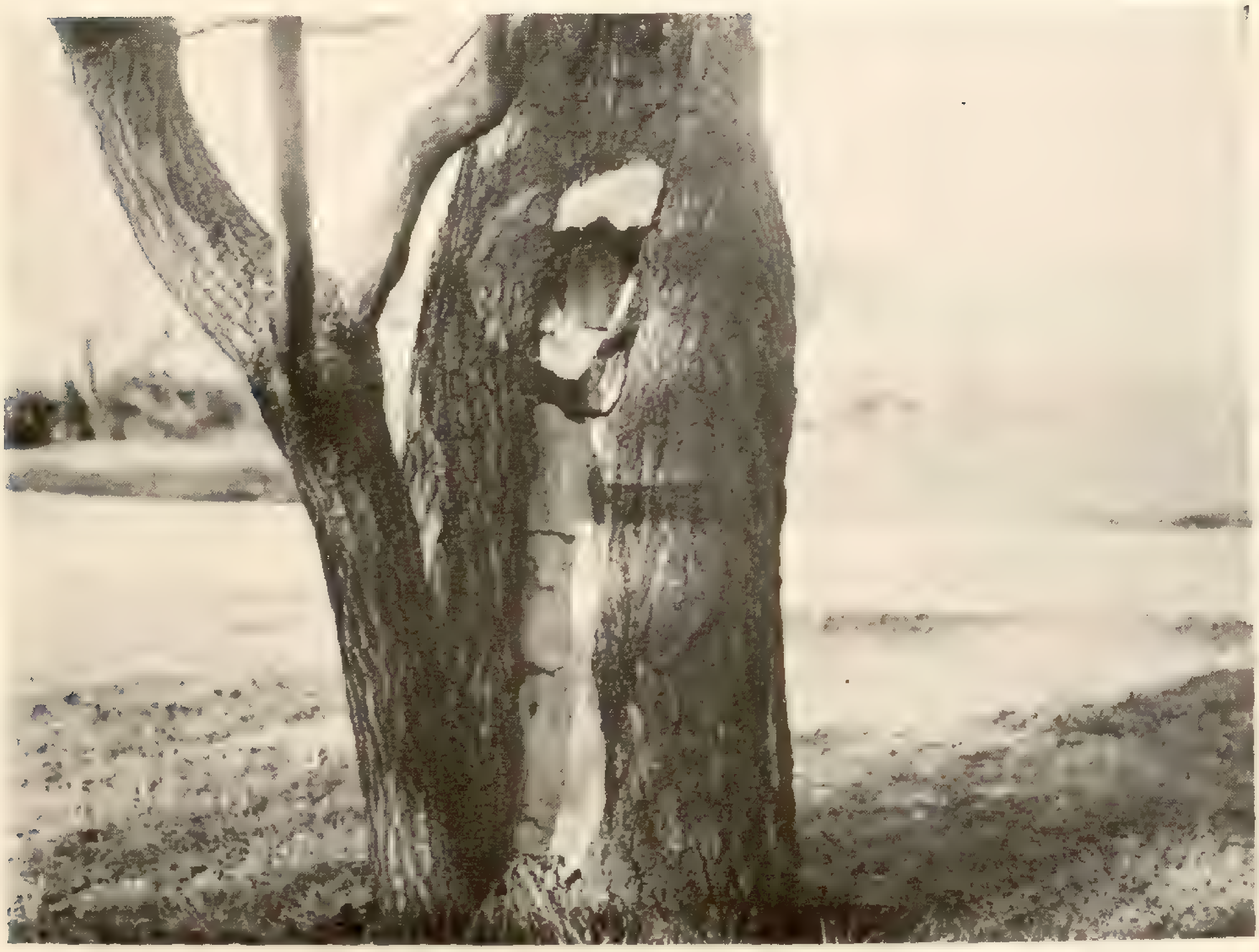
Under the first head are included creosote, carbolineum, corrosive sublimate, zinc chloride, copper sulphate, etc. Of these, creosote and carbolineum are most generally used, but as both are injurious to the cambium, a coat of shellac should be applied before the disinfectant.

The second class includes pure white lead and linseed oil paint, coal tar, slaters' cement, liquid grafting wax, and asphalt preparations. Paint and tar are the most commonly employed, sometimes with unsatisfactory results, due to the fact that checking occurs when the wood dries out, leaving numerous openings for parasites. This, however, may be readily remedied by applying another coat after checking has taken place. The asphalt preparations are gradually superseding the others, being tough, elastic, and quite permanent. They may be bought made up or prepared at home by melting the asphalt, then stirring in a quantity of fluxing oil such as gasolene or linseed oil, and finally adding some fiber to give it body. Whatever the dressing used, the work should be painstaking and thorough, for it is through the neglect of the wounds that decay begins and borers of all sorts infest the trees.

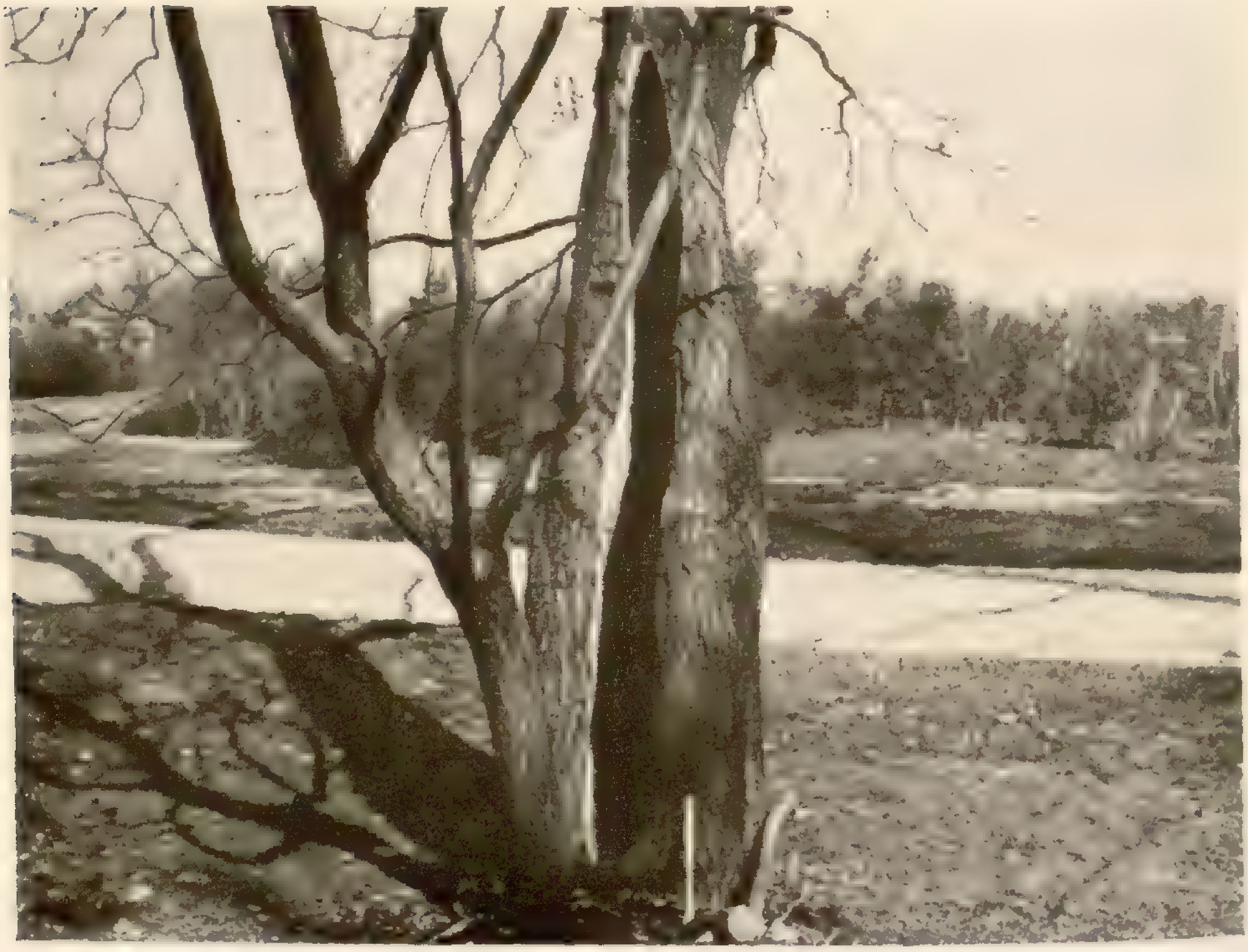
Should the preventative have been neglected and decay set in, the tree should then be treated to prevent further decay, protected from parasites, and strengthened if it is hollow. Before any work is done, however, several factors should be considered: Is the tree valuable enough to spend a large sum of money repairing it? Is it located in a section where an incurable disease, such as chestnut blight, is prevalent? Has it reached maturity? If so it might die off gradually despite repair. Is it situated in a grove, where it has no individual effect and where its absence will not be noticed? Has the fertilization, cultivation, watering been attended to properly? If after considering these points it is still deemed desirable to repair and fill a tree, the proper treatment must be determined upon. The cavities may be filled with concrete, asphalt, and other substances; they may be "tinned"; or the "open" system may be practised.

The preliminary steps for all these methods are similar. The tools used consist of carpenters' gouges ¾–1½ inch in width, wooden mallets, chisels, saw, pruning knife, gasolene torch, ladders, scaffolds, etc. The first step is to excavate thoroughly all the rotten wood, using the gouge or chisel or even the gasolene torch. The mouth of the cavity should be shaped so that it will be wider in than out to retain the filling, the upper and lower ends should be slanted downward to form water sheds, and the entire opening should have an oval form to facilitate healing. Then the cavity is braced by running ⅜–¾-inch machine bolts from the side of the opening diagonally through the back of the tree. These are inserted every 12–18 inches, for the purpose of preventing the filling from cracking off from the sides, due to torsional stresses upon the trunk. The hole for the bolt should be bored to be of the same diameter as the bolt, while a square opening should be made in the bark for the nut, deep enough to sink the bolt head under the bark so that it will be eventually grown over. The other side has a circular opening to allow for a washer. The cavity and bolts are then creosoted and later fumigated to kill any borers which may be in the sound wood. For this purpose a teaspoonful of carbon bisulphide is used to every cubic foot of cavity, the entire opening being covered with cloth or tar paper, and a piece of cotton saturated with the solution dropped into the cavity. If the cloth does not allow the fumes to escape, the borers are killed over night. The cavity is then ready for filling.

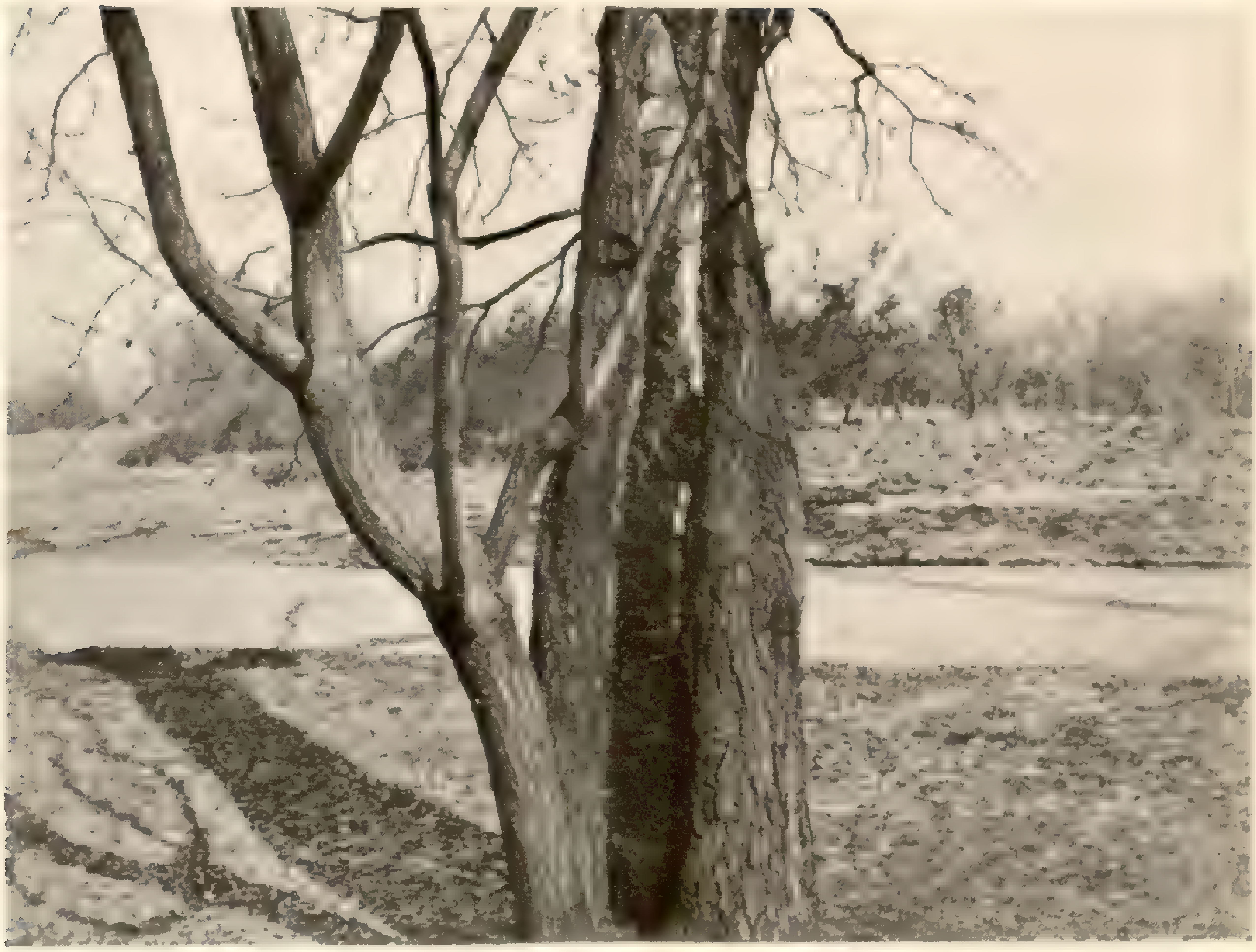
The material most commonly employed is concrete, either a dry or wet mixture of 1 to 4. The best Portland cement should be used, coarse sand, and ½-inch gravel. No reinforcement is necessary, except the bolts, as it will not prevent the cracking which is bound to occur because of the swaying of the tree. Moreover, the strengthening effect of the reinforcement is questionable because an inelastic substance like concrete cannot strengthen the elastic wood. The dry mixture is the easier to use. The concrete should be mixed so that it will not crumble, and is then laid in the cavity and brought out to within ¼ inch of the cambium layer. It is very important that the filling should be below the cambium to permit it to grow over eventually. The surface of the filling may be gone over with mortar to give it a smooth finish, and after drying out a coat of tar or fluxed asphalt is applied to make the concrete waterproof. The "dry" concrete has the disadvantage of disintegrating, as air spaces are left which are penetrated by water and the cement leaks out. The "wet" concrete method necessitates the use of a form. This may be made of wood, but that is not economical and requires driving nails into the bark. A wire netting is better, which may be inserted into the cavity, the concrete poured in and then faced with mortar made of a mixture of cement, lime, sand, and water (1 part of cement to 2 of lime and sand). Still another method requires the use of oil-cloth. Two



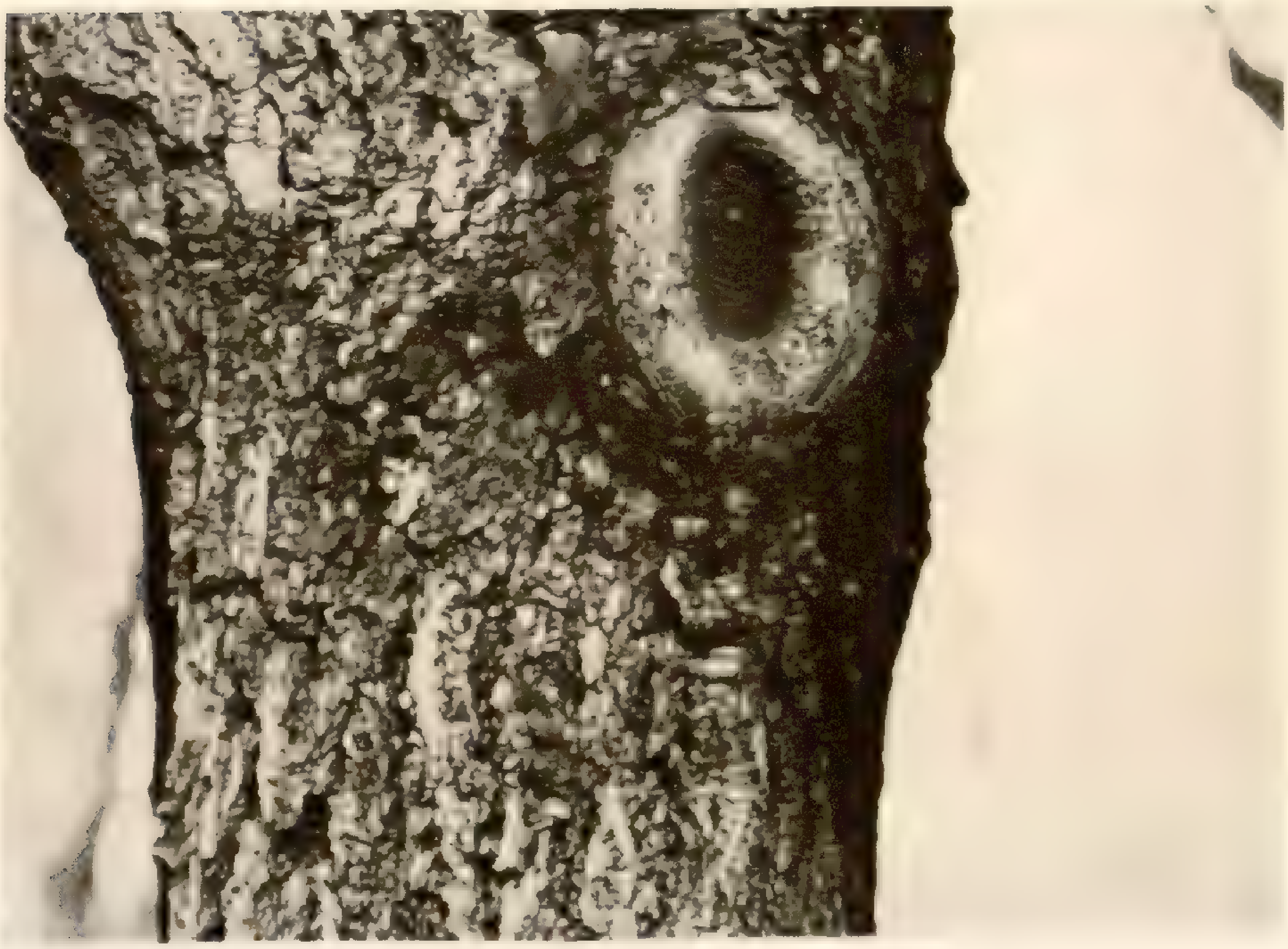
TREE IMPROPERLY FILLED WITH CONCRETE.



OLD FILLING TAKEN OUT AND CAVITY EXCAVATED.



FILLED WITH ASPHALT.



CALLUS GROWING OVER A WOUND.

sticks should be placed on either side of the opening and tied at the top and bottom by a rope running around the trunk. A piece of oil-cloth should then be cut to fit over the opening. It is tacked at the top, while the bottom is held in place by soil being banked against it. Beginning at the bottom a strip of canvas should be run from post to post to act as a support for the cloth. When 18 inches from the ground is reached the oil-cloth is turned back and into the form the wet concrete (1 to 4) is poured. Then a piece of newspaper or tar paper is laid on top to serve as an expansion joint. The canvas strips are again run up 18 inches and the operation repeated until the cavity is filled. In order to prevent the concrete from coming out to the surface of the bark, it is necessary to remove the oil-cloth in 3–4 hours, cut off the surplus material, bringing it back below the cambium, and face the filling with mortar.

Another material which is used for fillings and which bids fair to supersede concrete is asphalt mixed with sawdust or excelsior. Asphalt is elastic, while concrete is stiff, it adheres to wood perfectly, while concrete does not, and it is waterproof, while concrete absorbs water. Its one disadvantage is the difficulty of handling. The material comes in the form of little bricks or in bulk. In filling, a wall about two inches thick is built of the asphalt by dipping the bricks into hot asphalt and placing them in the opening of the cavity. As an extra precaution the bricks are nailed to the wood and one to the other. The cavity behind this wall may be filled with cinders, ashes, or asphalt. The wall is kept from bulging out or in by wire V-shaped braces running from it to the back of the tree. By using a gasolene torch or hot chisel the wall may be smoothed out and all crevices between the bricks filled. The asphalt for fillings may be prepared by stirring sawdust in boiling asphalt, using three parts of sawdust to one of asphalt.

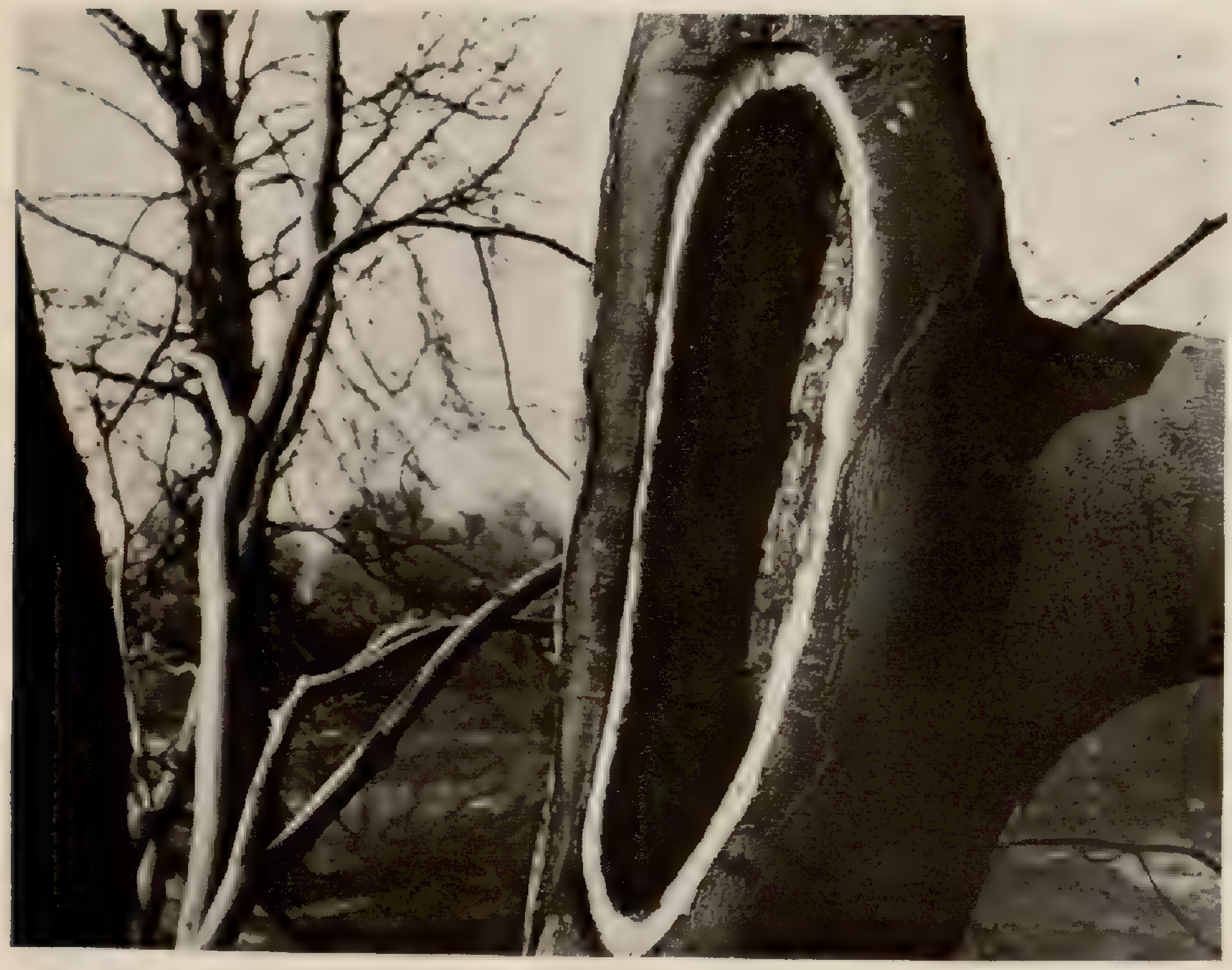
Small cavities may be quickly treated by "tinning." The excavation should be similar except that a ledge ¾ inch wide and ¼ inch below the cambium should be left all around the edge of the opening. A pattern should then be made and the metal fitted. The inside of the cavity as well as the metal should be painted and then the metal nailed to the ledge with galvanized nails placed one inch apart. Care should be exercised in getting the metal below the cambium layer, otherwise it will be torn off by the pressure of the ingrowing callus. After the first year the callus will grow over the nails, and there will be no danger of the metal giving in due to the strain of the callus rolling over.

If the cavity is long it is advisable to cut the metal into two or three sections, one lapping the other about 2 inches. The metal is painted over on the outside. Sheet zinc, copper, galvanized iron, and sheet iron are all used for the purpose, tin being used least of all, the term "tinning" being generic. The best of the materials is zinc, gauge No. 9.

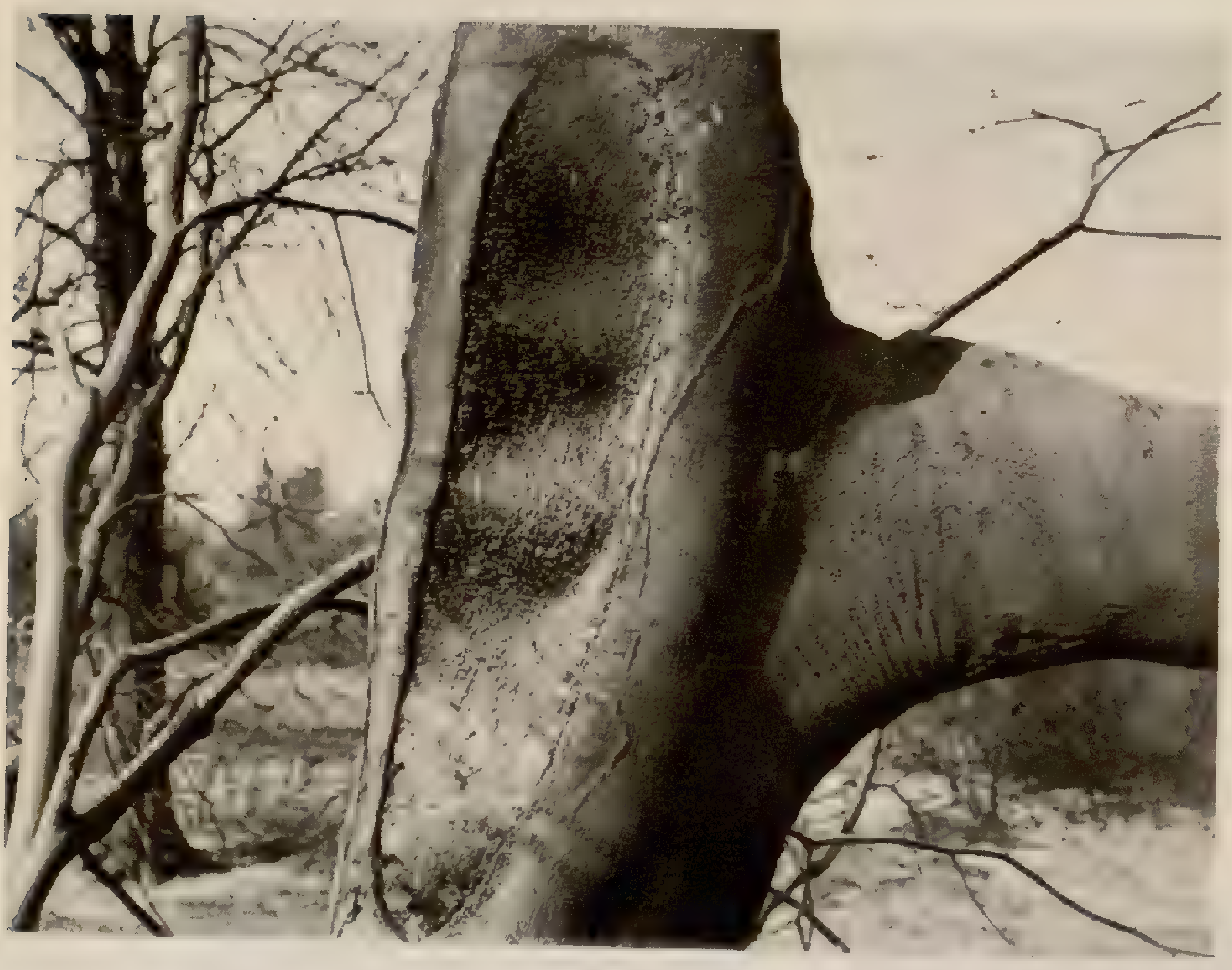
Where appearances do not count, when trees are badly damaged or have irregular cavities difficult to fill, the "open system" may be used. This consists simply of excavating and painting the entire cavity. This method is advantageous because it permits constant observation of the inside of the cavity, while fillings do not, it is quite cheap, less sound wood is cut, and it keeps out the fungi and insects quite as effectively as a filling. It has the disadvantage of not having any strength and of marring the beauty of the tree, but is finding many advocates.

Bracing is one of the essentials in tree surgery, particularly in preventing of wounds and consequent decay. Limbs require bracing when they are likely to get wrenched from the trunk, when they are decayed, when the wood is brittle, and when a tree is forked. The old style of bracing consisted of placing an iron band around the limb and connecting it with a chain to a similar band around the main trunk. The bands cut into the wood and killed the cambium, thus defeating the very purpose for which they were used. For best results an eye-bolt should be run through the limb and connected to another eye-bolt inserted in the trunk, by means of cable rope or iron rods. The cable is rather difficult to work, but after it is up, is the most satisfactory of any braces. In bracing small limbs several strands of galvanized wire should be run through the two eye-bolts, then bound together with a wire, and tightened by screwing on the nut of the eye-bolt. The eye-bolts will vary from ⅜–¾ inches, depending upon the size of the limb. The braces should be placed as high as possible, for according to the physical law of lever and fulcrum the further from the crotch is the support the less strength is required. Small trees may have their limbs braced by means of large screw eyes and fence wire, or the wire may be run through an opening in the limb double its diameter, and back again. A groove should be made at the back of the limb and a nail inserted under the wire to prevent it from slipping out.

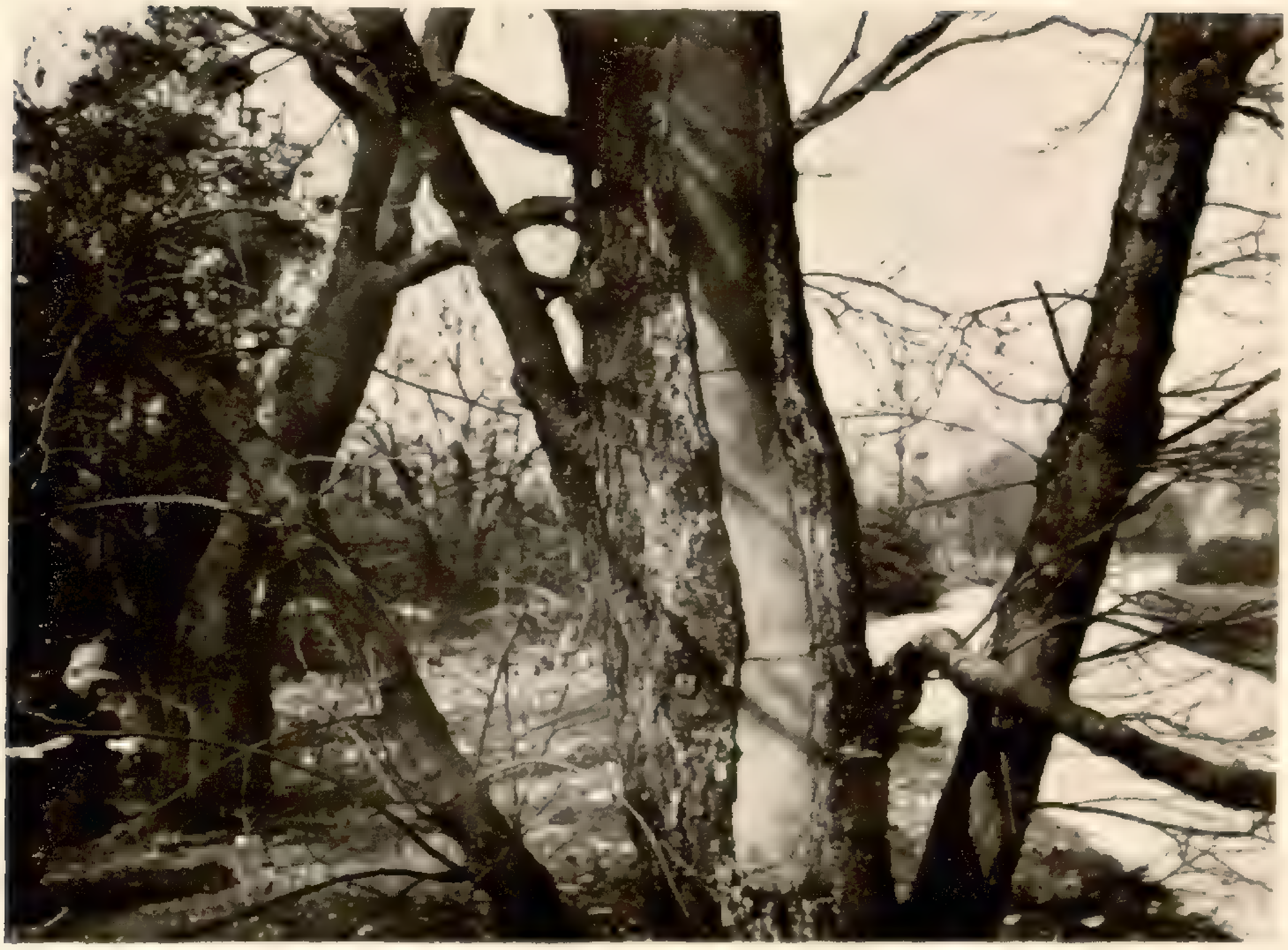
Many modifications of these methods are employed. For limbs overloaded with fruit a stick with an iron peg at the end is inserted into a hole on the under side of the limb.



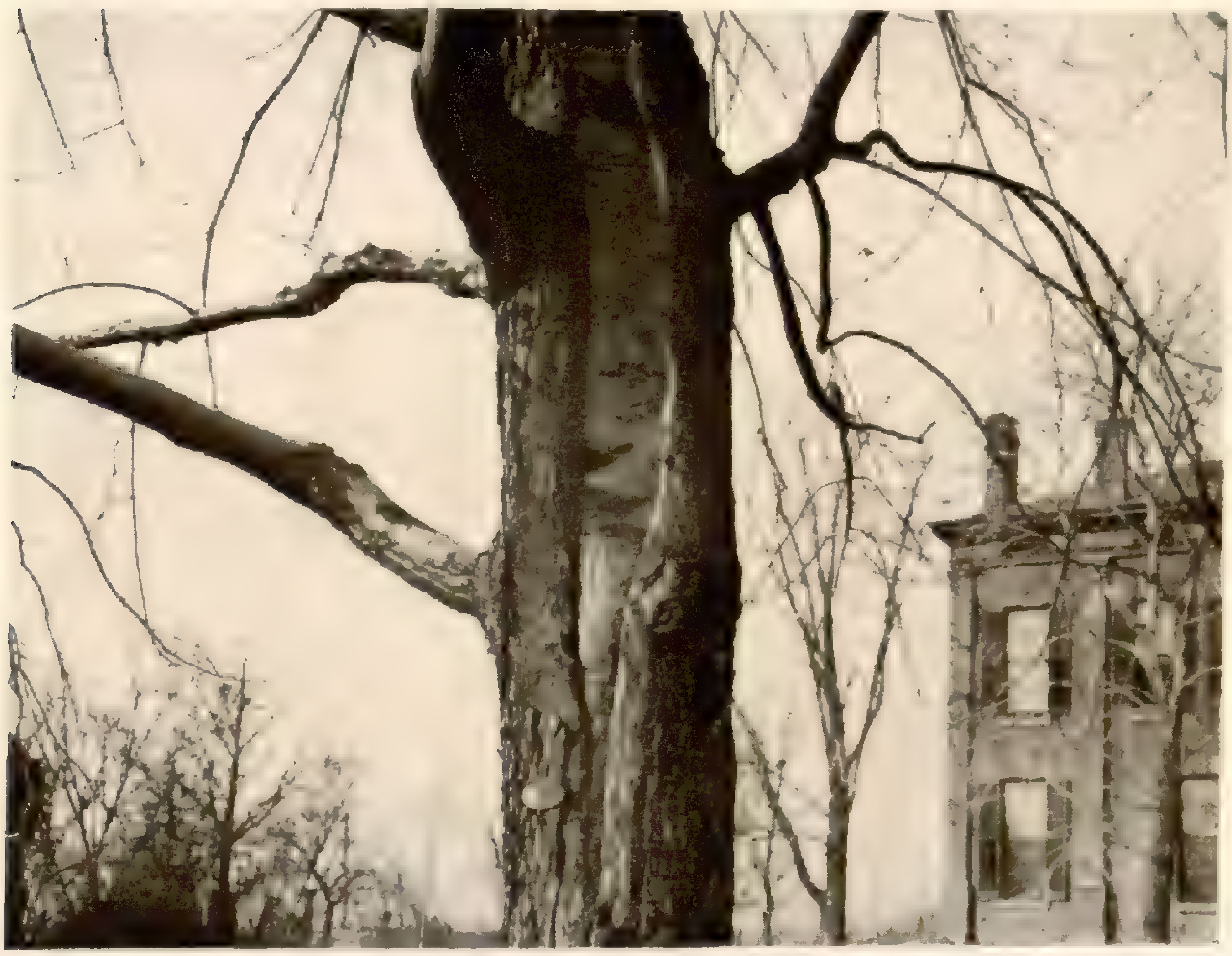
CAVITY READY FOR "TINNING".



"TINNED".



CAVITY FILLED WITH CONCRETE SHOWING EXPANSION JOINTS.



LOWER PART FILLED WITH CONCRETE, THE UPPER "TINNED".

The stick acts as a prop and if the fit is tight, it will sway with the wind and come down again still supporting the limb. For limbs that rub, buffers may be used, two pieces of wood or iron being attached to the upper and lower sides of the rubbing branches to keep the two apart. Iron buffers are made U-shaped out of rod iron. Limbs that have been partly severed may be restored by readjusting them, covering the wounds with liquid grafting wax, and bracing to the nearest healthy branch. Bracing may sometimes save trees that have been very seriously damaged by windstorms or lightning.

PLANTS IN THE CYCAD HOUSE

(Continuation of Plant Inventory)

Agathis loranthifolia. Coniferae.—An evergreen tree of the Malay Archipelago, from which dammar resin is obtained. It reaches 100 feet or more in height, and the leaves are broad, differing from pines and firs by their breadth and parallel veining.

Araucaria Bidwillii. Coniferae. Bunya-bunya. — A native tree of Australia, reaching a height of 150 feet, but rather narrow in growth, especially with age. The leaves are sharp-pointed, thick and shining. It makes an excellent house plant, and is hardy in Florida.

Araucaria braziliana. Coniferae.—A native of Brazil, attaining 100 feet in height. The branches are somewhat inclined, raised at the ends, tending to disappear below as the plant grows. The leaves are alternate, oblong, and sharp-pointed, and the cones are large and globular.

Araucaria excelsa. Coniferae. Norfolk Island pine.—A large tree of Norfolk Island, reaching a height of 200 feet and a diameter of 10 feet. The light green foliage on horizontal drooping branches is very attractive. It makes an excellent house plant and keeps well in a cool room near a window. In summer it may be placed in the shade outdoors.

Araucaria imbricata. Coniferae. Monkey puzzler.—A tree of Chile, attaining 100 feet in height. The branches are horizontal with upward curving tips which finally become deflexed. It is claimed that this is the only tree that a monkey cannot climb on account of the sharp, spine-like leaves which persist even on the trunk. The tree is hardy in the southern states.

Asparagus plumosus. Liliaceae. Asparagus fern.—A tall climber with spiny stems, a native of South Africa. The branches are flat, spreading horizontally in sprays. The flowers are white and insignificant, and the berries black. This is one of the most popular of decorative plants, the cut stems holding their shape and color for a long time. The variety *nanus* is more dwarf and is used for a pot plant.

Asparagus Sprengeri. Liliaceae. — A drooping plant of Natal, with fleshy, white tubers and long, slender, branching stems. The leaves are glossy green, the berries red. This is a popular hanging-basket plant, and the sprays are used extensively in decorative work by florists. It is commonly propagated by seeds or division.

Bowenia spectabilis var. *serrulata.* Cycadaceae. — A Zamia-like cycad of Queensland, Australia. The trunk is thick, scarcely rising above the ground. The plant is glabrous, with leaves 3–4 feet long, resembling those of holly fern (*Cyrtomium falcatum*). It is hardy in Florida, and makes a fine plant for decorative effects.

Ceratozamia mexicana. Cycadaceae.—A handsome Mexican foliage plant with Cycas-like leaves. The trunk is thick, short, and covered with the remains of fallen leaf stalks. The leaves are dark green with numerous leaflets. The cones are produced annually.

Ceratozamia mexicana var. *longifolia.* Cycadaceae.—A plant similar to *C. mexicana,* but with longer and narrower leaflets.

Ceratozamia Miqueliana. Cycadaceae. — A native of Mexico and the West Indies. The leaf stalk is 18 inches long, with 20–30 pairs of leaflets. The plant is seldom cultivated except in conservatories of botanic gardens, but deserves a wider use.

Ceratozamia terrestris. Cycadaceae.—A South American plant attaining a height of 3 feet. The leaves are 18–24 inches long, with long leaflets serrated at the point.

Cupressus Corneyana. Coniferae.—A tall, pyramidal tree of the Himalayan region. It reaches 150 feet in height, and has pendulous branches and oblong cones.

Cupressus glauca. Coniferae.—An evergreen tree growing 50 feet high. Its original habitat is unknown, but it is supposed that it was introduced from India. It is extensively cultivated in Portugal.

Cupressus sempervirens. Coniferae.—An evergreen tree of southern Europe and western Asia. It grows to 80 feet in height, with erect or horizontal branches and dark green foliage. It is useful for ornamental effects, and is much planted about Mohammedan burial grounds in the neighborhood of Constantinople.

Cupressus thurifera. Coniferae. — An evergreen tree reaching 70 feet in height, with horizontal branches forming a pyramidal head. It is a native of Mexico.

Cycas circinalis. Cycadaceae. Fern palm.—This species differs from the sago palm in being somewhat taller, rarely branching, and having longer, gracefully arching leaves. It is a native of the Molucca Islands.

Cycas media. Cycadaceae. Nut palm. — An Australian cycad reaching 15 feet in height. The trunk is cylindrical, and bears a large crown of leaves curved downward, with numerous glaucous leaflets.

Cycas revoluta. Cycadaceae. Sago palm. — A Japanese plant becoming 6–10 feet high with the trunk simple or branching. The leaves are long and recurved at the end, with many narrow, curved, sharp-pointed, stiff, shining green leaflets. The seeds are eaten by the natives, and sago is obtained from the inner part of the trunk. The leaves are dried, pressed, dyed green, and exported to America where they are used in decorative work and funeral designs. The cycads serve as a connecting link between the ferns and the higher seed-bearing plants.

Cycas tonkinensis. Cycadaceae. — A native of Tonkin, China. The trunk is slender, cylindrical, erect, wholly covered with large round scales. The leaves are slightly recurved, glabrous, and the leaflets are sessile, long, and pointed. The petioles are woolly with robust spines.

Cyperus alternifolius. Cyperaceae. Umbrella plant.—A plant of the sedge family, native of Madagascar. The stem reaches 4 feet in height and is crowned with about 20 leaves forming an umbel. The plant is much used in aquaria and jardinieres.

Dioon edule. Cycadaceae.—A Mexican cycad-like plant, with glabrous leaves 3–5 feet long. The leaflets are wedge-shaped and number about 100 on each side. The cones are cylindrical, bearing large seeds about the size of a Spanish chestnut, which are eaten by the natives. The plants are used decoratively. The genus is said to be the closest to the fossil forms of any representative of the Cycadaceae.

Dioon spinulosum. Cycadaceae.—This plant is a native of Mexico, and differs mainly from *Dioon edule* in having the leaflets margined with small, sharp points.

Encephalartos Altensteinii. Cycadaceae. Kafir bread.—A South African plant having a stout trunk and a terminal crown of stiff pinnate leaves with spiny apex. The cones or fruits of the female plants are soaked in water and eaten by the natives of Africa, hence the name Kafir bread.

Encephalartos caffer. Cycadaceae.—A large plant, native of South Africa, with a trunk reaching 18 feet in height and 1 foot or more in diameter. The leaves are 4 feet long, stiff and recurved, with alternate, twisted leaflets.

Encephalartos horridus. Cycadaceae.—A cycad-like plant of South Africa with a short trunk, sometimes woolly. The leaves are up to 6 feet long, with lanceolate leaflets which have a sharp spine at the apex.

Encephalartos villosus. Cycadaceae.—A South African cycad with a thick, short, woolly trunk up to 6 feet. The leaves are long, with numerous spiny-toothed leaflets.

Encephalartos lanuginosus, E. elongatus, and *E. Hildebrandtii,* South Africa.

Eucalyptus globulus. Myrtaceae. Blue-gum.—One of the largest trees known, occasionally reaching a height of 300 feet. It is native of Victoria and Tasmania and there, as well as in California and other localities in which it has been introduced, makes a remarkably rapid growth. The trunk and foliage are grayish blue. The hard wood is employed for a great variety of purposes, including mill work, ship-building, etc. The fruits are occasionally used for making rosaries and necklaces. The leaves possess febrifugal properties, and further, are smoked in the form of cigars or cigarettes as a remedy for asthma. Eucalyptus oil, employed in medicine against asthma and bronchitis, is distilled from the fresh leaves of this and other species of the genus.

Eucalyptus rostrata. Myrtaceae. Red-gum.—A native of Italy, reaching 200 feet in height. It thrives in ground periodically inundated for a considerable time. The timber is somewhat harder than *E. globulus* and extremely durable, and is suitable for fence posts, ties, piles. It is also used in ship-building and for wood bricks for street paving. The flowers yield much honey for bees.

Eucalyptus melliodora. Myrtaceae. Honey-scented gum. —A spreading tree of Australia, reaching a height of 120 feet. The bark is brownish gray without, yellowish within. The timber is used by wheelwrights and ship-builders, and it also makes excellent fuel. The flowers are particularly rich in nectar, and much sought by bees.

Ficus repens. Urticaceae. Creeping fig.—A prostrate or climbing shrub of Japan, China, and Australia. The vine is used extensively in conservatories where it clings close to the walls. The leaves are oval, heart-shaped at base, and borne on very short petioles.

Hakea varia. Proteaceae.—An Australian shrub, attaining a height of 8 feet. The flowers are pink in long racemes, and the leaves are flat, with many nerves. It is slightly cultivated outdoors in California.

Jacquinia pungens. Myrsinaceae. — An evergreen shrub of tropical America, with narrow leaves crowded at the tops of the branches. It is an attractive conservatory plant.

Macrozamia Moorei. Cycadaceae. — An Australian cycad growing to 20 feet in height, while the diameter of the trunk reaches 2 feet. The trunk is surmounted by a crown of leaves numbering as many as 100. The cones are striking on account of their size and large number, 100 having been recorded on a single plant.

Macrozamia Paulo-Guilielmi. Cycadaceae. — An Australian plant closely resembling the cycad, except that the leaflets have no midrib. The trunk is short with leaves 1–3 feet long. The plant is useful as a single specimen, but combines poorly in any scheme of decoration.

Macrozamia spiralis. Cycadaceae.—A very handsome Australian plant with shining green, pinnate leaves 1–3 feet long. The bases of the leaflets are white, forming a broad central stripe.

Marchantia polymorpha. Marchantiaceae. Liverwort.— A liverwort of North America which grows in moist locations, spreading its leaf-like forking thallus over soil or masonry. The thallus is often 4–5 inches long and 1 inch or more in width, and from it arise the reproductive bodies upon slender peduncles.

Nephrolepis exaltata var. *bostoniensis.* Polypodiaceae. Boston fern.—A fern, native of tropical Africa. The stalks are 4 feet or more long, the leaflets being set close, and usually acute with crenate or entire edge. This is one of the most popular of the ferns, and is used for decorative work of all sorts. It makes a fine house plant.

Ophiopogon japonicus. Haemodoraceae. Snake's beard. —A perennial, stemless, glabrous herb of Japan with a stoloniferous rhizome. The leaves are dark green, narrowly linear, 1 foot long. The flowers are in racemes, purplish or whitish. The plant is useful as a border in conservatories.

Passiflora edulis. Passifloraceae. Passion-flower. — A climbing woody plant of Brazil, with large, deeply three-lobed leaves. The flowers are white, tinted with purple. The fruit is globular, purple-dotted, with hard rind, and is edible and fragrant but contains little pulp. The name "passion-flower" is given because of the odd flowers which were fancied by Spanish and Italian travelers to represent the implements of crucifixion.

Pellionia Daveauana. Urticaceae. — A tender, creeping foliage plant of Burma. The leaves are dark bronzy green flushed with violet or red, with a fern-like figure of light green down the middle. It is used for ornamental purposes in covering rock work or banks in conservatories.

Podocarpus neriifolia. Coniferae.—A tree of the Himalayan region, attaining 50 feet in height, with whorled spreading branches. The leaves are acuminate, long, dark green above, and glaucous beneath. The plant is much used in conservatories.

Podocarpus japonica. Coniferae. — An ornamental evergreen tree of Japan, attaining 30 feet in height. It is used as a pot plant to some extent.

Selaginella cuspidata. Selaginellaceae. Club moss.—A club moss of Central America, with densely tufted stems 6 or more inches long, and copiously compound branches. The plant is used for table decoration or for covering banks in greenhouses.

Stangeria paradoxa. Cycadaceae. Hottentot's head.—A South African cycad.

Taxodium mucronatum. Coniferae. — A tall evergreen tree of Mexico, reaching 170 feet in height and 20 feet or more in diameter. The wood is used for timber.

Zamia furfuracea. Cycadaceae.—A Mexican species with a cylindrical trunk reaching 2 feet in height. The leaves consist of about 10–12 pairs of downy leaflets. The cone is oval, downy, and pale yellowish brown. The petioles of the leaves are prickly at the base.

Zamia integrifolia. Cycadaceae. — A simple-stemmed, Cycas-like plant of the West Indies. The trunk is 12–18 inches tall, erect, globular or oblong. The leaves are glabrous with 7–16 pairs of alternate, oblong leaflets. The fruit is a berry-like drupe borne upon a cone. The pith of the stems contains sago.

Zamia media. Cycadaceae.—A native of Florida and the West Indies. The leaflets average 18–20 on both sides, are obovate-oblong, and 2 inches long. The petioles of the leaves are unarmed, scurfy-pubescent.

Zamia Van Houttei. Cycadaceae. — A plant reaching 3 feet in height, with leaves 1–2 feet long. The leaflets are 6 inches long, strap-shaped, finely serrate towards the tip.

Zamia costaricensis, Costa Rica. *Z. Loddigesii,* Caracas.

NOTES

The Rufus J. Lackland fellowships for the year 1917–1918 have been awarded as follows:

Mr. W. W. Bonns, B.S. Massachusetts Institute of Technology, 1899; B.S.A. Cornell University, 1909; reappointed third year.

Mr. C. W. Dodge, A.B. Middlebury College, 1915, reappointed third year.

Mr. D. C. Neal, B.S. Mississippi A. & M. College, 1909; A.M. Washington University, 1916; reappointed second year.

Mr. Henry Schmitz, B.S. University of Washington, 1915; M.S. University of Washington, 1916; reappointed second year.

Mr. W. H. Chambers, B.S. University of Illinois, 1915.

Appointments as teaching fellows in the Henry Shaw School of Botany for the coming year are: Mr. J. W. Severy, A.B. Oberlin College, 1915, reappointed third year, and Mr. E. B. Payson, B.A. University of Wyoming, 1917.

Dr. S. M. Zeller has been appointed special investigator by the Yellow Pine Association to continue his studies on the durability of woods, the Garden coöperating in this project by permitting the use of the facilities of the graduate laboratory.

The delegates to the Advertising Convention and their wives visited the Garden on June 7.

Dr. George T. Moore, Director of the Garden, spoke at the Kirkwood City Hall on "Vegetables," May 4.

On his return from California Dr. E. M. East, Professor of Genetics, Harvard University, spent June 8 and 9 at the Garden.

Professor W. E. McCourt, Professor of Geology, Washington University, gave an illustrated lecture on "Geology" before the Hortus Club, June 4.

Mr. L. L. Harter, Plant Pathologist, Bureau of Plant Industry, was at the Garden, June 12, for the purpose of examining the Texas root rot fungus.

Dr. George T. Moore, Director of the Garden, delivered the valedictory address to the St. Louis College of Pharmacy, at the Sheldon Memorial on May 16.

Among those visiting the Garden during June were Mr. W. B. Lanham, of the Agricultural Extension Department of Texas A. & M. College; Dr. A. G. Johnson, of the University of Wisconsin; Prof. L. L. Burlingame, of Leland Stanford University; and Dr. W. H. Emig, of the University of Pittsburgh.

Dr. Hermann von Schrenk, Pathologist to the Garden, recently placed on deposit in the Garden library a very rare work entitled "Flora Monacensis, seu plantae sponte circa Monachium nascentes, quas pinxit et in lapide delineavit Johann Nepomuk Mayrhofer" by Franz von Paula Schrank, 1811–1816, also "Charakteristik der für die Arzneikunde und Technik wichtigsten Pflanzen-Gattungen", by Otto Karl Berg, 1861, and "Deutschlands Flora," by Ernst Hallier.

At the commencement of Washington University, June 14, degrees were conferred on the members of the graduate laboratory as follows: Doctor of Philosophy, G. W. Freiberg, with a thesis on "Studies in the mosaic diseases of plants"; and S. M. Zeller, "Lenzites saepiaria Fries, with special reference to enzyme activity." The degree of Master of Arts was conferred on Ruth Beattie, thesis "Temperature relations of enzymes with special reference to the effects of various temperatures upon the formation of glucose from starch by the action of diastase"; Alice Pickel, "A taxonomic study of the genus Tetradymia"; and

R. A. Studhalter, "The factors involved in the dissemination of the chestnut bark disease."

Members of the graduate laboratory registered during the past year for the advanced degrees in the Henry Shaw School of Botany of Washington University have made the following arrangements for the period of the summer or longer: Dr. G. W. Freiberg, Messrs. W. S. Reeves, and J. W. Severy enlisted in the Washington University Base Hospital, Unit 21, and are now in France; Dr. S. M. Zeller will give work in the summer school at the Puget Sound Marine Station; Mr. D. C. Neal has undertaken a study of the citrus canker in Alabama in coöperation with the state and federal service; Mr. I. C. Hoffman is continuing his investigations of cucumber troubles in Indiana, a project involving the coöperation of the Bureau of Plant Industry and the Heinz Co.; Mr. C. W. Dodge is devoting the summer to agricultural work at his home, Pawlet, Vermont; Mr. Henry Schmitz will assist in the summer work in botany at the University of Washington; Mr. H. M. Jennison returns to Montana Agricultural College as Assistant Professor of Botany; Mr. R. A. Studhalter is engaged upon a study of the rusts of conifers undertaken by the office of Forest Pathology, U. S. Department of Agriculture, in the state of Washington; and Messrs. W. W. Bonns and L. J. Pessin will spend the summer in the laboratory at the Garden.

STATISTICAL INFORMATION FOR MAY, 1917

Garden Attendance:	
Total number of visitors	18,275
Plant Accessions:	
Total number of plants donated	52
Total number of plants received in exchange	233
Plant Distribution:	
Total number of plants distributed in exchange	9
Library Accessions:	
Total number of books and pamphlets bought	22
Total number of books and pamphlets donated	72
Herbarium Accessions:	
By Purchase —	
G. W. Freiberg—Plants of Washington	573
J. Holzinger—"Musci Acrocarpi Boreali-Americani" Nos. 351–375	25
By Exchange —	
Gray Herbarium, Harvard University—Plants of Newfoundland	209
E. L. Johnston—Plants of Iowa and Kansas	27
E. E. Sherff—Photographs of *Bidens*	24
By Gift —	
F. E. Clements—*Oenothera bistorta* Nutt. from California	1
J. J. Davis—"Fungi Wisconsinenses Exsiccati," Decades III and IV, Nos. 21–40	20
J. A. Drushel—Plants from various states	14
Dr. W. G. Farlow—Algae and lichens from various localities	375
Mrs. Ida M. Jackson—White-flowered form of *Viola cucullata,* also specimen of *V. blanda*	2
Dr. H. von Schrenk—Plants of Europe collected by G. Hieronymus chiefly in Silesia	118
Total	1,388

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

Benjamin Minge Duggar,
Physiologist in charge of Graduate Laboratory.

Hermann von Schrenk,
Pathologist.

Jesse M. Greenman,
Curator of the Herbarium.

Edward A. Burt,
Mycologist and Librarian.

J. C. Th. Uphof,
Assistant Botanist.

Katherine H. Leigh,
Secretary to the Director.

James Gurney,
Head Gardener, *Emeritus.*

William W. Ohlweiler,
General Manager.

John Noyes,
Landscape Designer.

Alexander Lurie,
Horticulturist.

A. B. McIntyre,
Outdoor Gardens.

J. J. Coughlin,
Construction.

P. Foerster,
Farm and Stables.

W. F. Langan,
Engineer.

G. H. Pring,
Conservatories.

M. Schiller,
Floral Displays.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. V JULY, 1917 No. 7

CONTENTS

Page
School for Gardening of the Missouri Botanical Garden 107
Notes - - - - - - - - - - 116
Statistical Information - - - - - - 117

ST. LOUIS, MO.
1917
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

EDWARD C. ELIOT.

GEORGE C. HITCHCOCK.

P. CHOUTEAU MAFFITT.

EDWARD MALLINCKRODT.

LEONARD MATTHEWS.

WILLIAM H. H. PETTUS.

PHILIP C. SCANLAN.

JOHN F. SHEPLEY.

EX-OFFICIO MEMBERS

EDMUND A. ENGLER,
President of The Academy of Science of St. Louis.

FREDERIC A. HALL,
Chancellor of Washington University.

HENRY W. KIEL,
Mayor of the City of St. Louis.

BENJAMIN P. STROMBERG,
President of the Board of Public Schools of St. Louis.

DANIEL S. TUTTLE,
Bishop of the Diocese of Missouri.

ROLAND W. SWITZER, Secretary.

SPRAYING.

PLANTING WATER-LILIES.

Missouri Botanical Garden Bulletin

Vol. V St. Louis, Mo., July, 1917 No. 7

SCHOOL FOR GARDENING OF THE MISSOURI BOTANICAL GARDEN

In accordance with the intention of Henry Shaw, the Trustees of the Garden, November 19, 1889, passed resolutions providing theoretical and practical instruction for young men desirous of becoming gardeners. A brief summary of these resolutions is given in the December, 1914, number of the BULLETIN. In 1914 the courses of instruction were entirely reorganized, and the scope of the school enlarged in conformity with the following resolutions passed by the Board of Trustees on March 11 of that year:

> RESOLVED, That the action taken by the Board concerning garden pupils on November 19, 1889, and subsequently amended on March 9, 1892, and February 11, 1903, together with the action of the Board, taken at its meeting November 16, 1894, authorizing additional garden pupils which should pay a tuition, be rescinded.
>
> RESOLVED, That there be established the number of six scholarships for garden pupils of the Missouri Botanical Garden, each of the value of $350.00 annually, to be available on and after October 1, 1914; such scholarships to be awarded by the Director of the Garden on the results of competitive examination, to applicants between the ages of sixteen and twenty years, of good character, and possessing at least the education afforded by completing a regular high school course of recognized standing, or its equivalent; each scholarship to grant such privileges and be subject to such conditions as are provided below, or may subsequently be imposed by the Trustees of the Garden.
>
> Each scholarship so conferred may be held by the original recipient for a period not exceeding three years, subject to the following conditions:
>
> Each garden pupil shall show such progress as to satisfy the Director that the opportunities afforded are being appreciated, and from time to time will be subject to both theoretical and practical examinations. Garden pupils shall lead a strictly upright and moral life and shall be courteous and willing in the performance of all duties prescribed. Failure to meet the requirements in any of these respects shall forfeit all claim to any scholarship.
>
> Upon the satisfactory completion of the regular garden course, the holder of a scholarship shall be examined, and on passing such examination to the satisfaction of the Garden Committee and Director, shall receive a certificate indicating the work done.

> RESOLVED, That there be admitted to the garden course, in addition to those holding garden scholarships, as many suitably prepared pupils as can in the judgment of the Director be adequately taught; each pupil so admitted to be charged $50.00 per year tuition and to be entitled to a regular certificate on the completion of the prescribed course and examination. It is further provided that properly prepared individuals may take a single course at a cost of $15.00 for each course extending throughout the year, and a fee of $5.00 for each course covering three months or less.
>
> RESOLVED, That the Director be instructed to prepare regulations concerning applications for scholarships, examinations, vacations, courses of study, and such other matters necessary to properly carry out the provisions of the above resolutions and for the establishment of a garden course along the lines indicated in the Director's report for the month of February, 1914.

Owing to the unique opportunities at the Garden, it is believed that this school has taken first rank with similar institutions throughout the world. Although numerous institutions in this country give a part of the work necessary for fitting young men and women to be competent gardeners and superintendents, there is no one place which so admirably combines theoretical instruction with facilities for practical experience as the Missouri Botanical Garden.

In 1916 the course of instruction was augmented and strengthened to conform to the greater requirements of the profession. It may be roughly divided into four parts: botany, horticulture, engineering, and landscape architecture.

The courses in botany deal with the form, structure, taxonomy, and economic use of plants. The student is taught to recognize the lower as well as the higher forms of plant life under various conditions and is made acquainted with the history, culture, and uses of the economic plants producing edible parts, gums, oils, perfumes, condiments, medicinal ingredients, textiles, etc.

The horticultural courses comprise instruction in the care of all phases of plant life, both in the greenhouses and outdoors. The fundamentals of soils and fertilizers and their application are given proper attention. The forcing of flowers, vegetables, and fruits, for commercial as well as private purposes, is taken up in detail, and trips to other greenhouse establishments help to broaden the student's ideas. Considerable time is devoted to the study of the treatment of outdoor plants—trees, shrubs, herbaceous perennials, annuals, bulbs, tropical and water-loving plants, consideration being given to the means of control of various fungous and insect pests.

DRAFTING ROOM.

SURVEYING.

The courses in landscape architecture are arranged to start the student properly in the study of this profession. The Garden has an excellent collection of the best books on various phases of the subject, which are constantly referred to. In the course in principles of landscape gardening, study is made of the best American and foreign examples of the art. In landscape design the student gets valuable practice in the design of home grounds, country estates, parks, and playgrounds, and as much time as possible is devoted to drafting and rendering, in all courses. With its numerous and varied gardens, its excellent collection of plants, and its new undertakings, the Garden is particularly well equipped for instruction and practice in planting design. The course, called here garden architecture, is intended to familiarize the student with the various styles and monuments of architecture, as well as to provide practice in the design of the minor architectural structures associated with gardens.

The courses in surveying and construction give the student thorough practical knowledge of those branches of those subjects particularly essential to the landscape architect and gardener. In addition to the theoretical instruction in surveying, all students, in their morning work, receive considerable practical training in making and plotting topographical surveys, in leveling, staking out new buildings and gardens, and in setting grades and batter boards. The transit and stadia are most frequently used in the making of our topographical surveys, with triangulation as the basis of the operation. In construction the student keeps in constant touch with the new developments of the Garden and with various engineering undertakings in the city. The lectures and designs are devoted especially to those types of structures so important to landscape developments, considerable attention being given to grading design and earthwork computations. Greenhouse construction involves the study of various types and methods of construction and heating.

The courses are arranged so that all theoretical instruction is given in the afternoon. The morning work comprises practical application in the various departments of the Garden and enables the student to come into actual contact with culture and care of a large and varied collection of plants. This affords the student an opportunity to apply the theoretical knowledge gained to practical details, and results in the rare product, who may be placed in a responsible position upon graduation, with every chance of success.

OFFICERS OF ADMINISTRATION AND INSTRUCTION

George Thomas Moore, A.M., Ph.D., *Director of the Garden, and Engelmann Professor in the Henry Shaw School of Botany of Washington University.*

Jesse More Greenman, A.M., Ph.D., *Curator of the Herbarium, and Associate Professor in the Henry Shaw School of Botany of Washington University.*

Edward Angus Burt, A.M., Ph.D., *Mycologist and Librarian to the Garden, and Associate Professor in the Henry Shaw School of Botany of Washington University.*

Harry Milliken Jennison, A.B., A.M., *Assistant in Botany in the Henry Shaw School of Botany of Washington University.*

William Woodward Ohlweiler, B.S., A.M., *General Manager to the Garden.*
B.S., Connecticut Agricultural College; A.M., Washington University; Missouri Botanical Garden, 1907-; Teaching Fellow, Washington University, 1912-13.

John Noyes, S.B., *Landscape Designer to the Garden.*
S.B., Massachusetts Agricultural College; Instructor in Landscape Gardening, Massachusetts Agricultural College, 1909-11; with Warren H. Manning, Boston, 1911-14; Missouri Botanical Garden, 1914-

Alexander Lurie, B.S., *Horticulturist to the Garden.*
B.S., Cornell University; charge of ornamentals and greenhouses, Greening Bros. Nurseries, Monroe, Mich., 1913-14; Instructor in Floriculture, in charge of greenhouses and grounds, University of Maine, 1914-16; Missouri Botanical Garden, 1916-

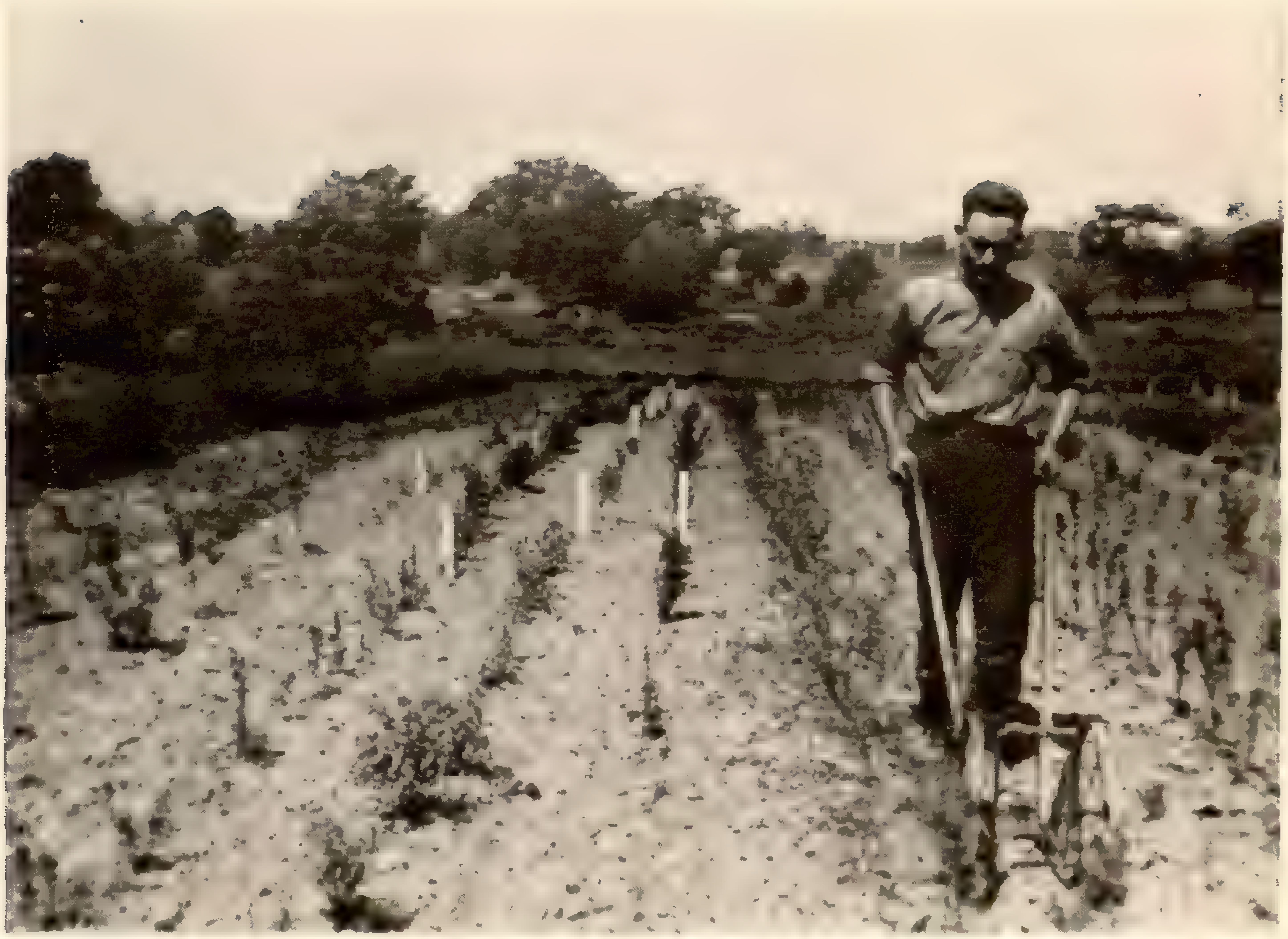
George Harry Pring, *Orchids and other Exotics.*
Royal Botanic Gardens, Kew, 1899-1906; Missouri Botanical Garden, 1906-

COURSES OF INSTRUCTION

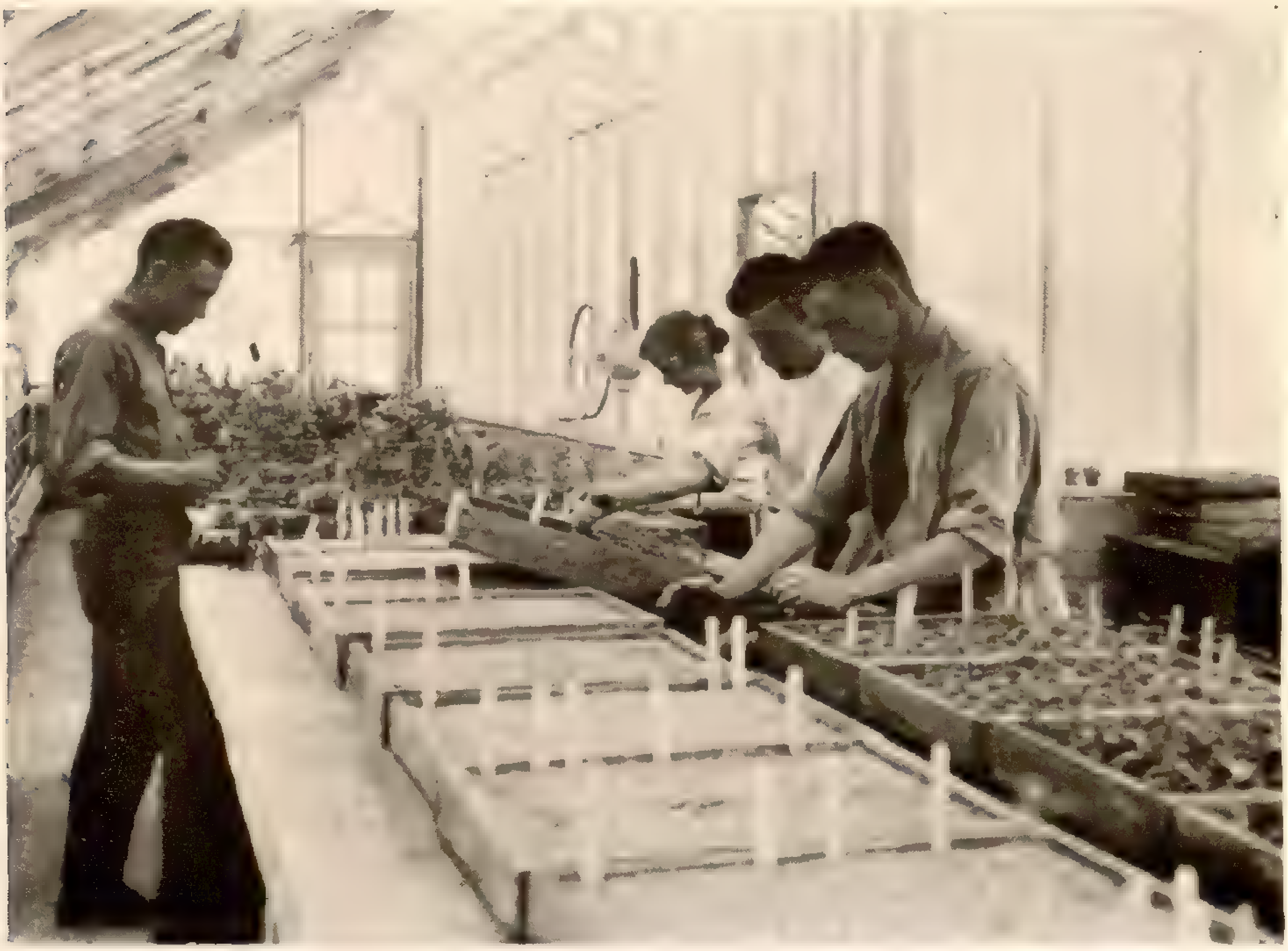
First Year

1. General Botany. (At Washington University.) Laboratory course with lectures and quizzes dealing with the form and structure of plants, with special reference to their life processes. A brief study will be made of living plants in relation to their environment. October to July. (Jennison)

2. General Floriculture. The general principles of greenhouse management. Methods of propagation by seeds,



CULTIVATING IN NURSERY.



POTTING, PRICKING OFF, MAKING CUTTINGS.

cuttings, division, layering, grafting, etc., under glass and outdoors. Cultural methods for successful growing of outdoor roses, bulbs, tubers, decorative and bedding plants, etc. October to April. (Lurie)

3. COMMERCIAL FLORICULTURE. Culture of roses, carnations, chrysanthemums, violets, orchids, sweet peas, bulbs, ferns, palms, and other decorative and flowering plants. Marketing, packing, shipping, designing. April to October. (Lurie)

4. VEGETABLE GARDENING. Methods of growing, harvesting, and marketing vegetables for commercial purposes. Home gardens. July and September. (Lurie)

5. DISEASE CONTROL. Methods of control of fungous and insect diseases affecting greenhouse and other cultivated plants and trees. Sprays and spray machinery. April to October. (Lurie)

6. SURVEYING. Topographical surveying and plotting, principally with the Wye level and transit, using the stadia. Practice in the use of the hand level, compass, etc. Staking out, setting grades, etc., from plans. October to April. (Noyes)

7. CONSTRUCTION. Grading design and earthwork, foundations, roads and walks, drainage, sewage and water supply, plain and reinforced concrete, building materials, elements of structural design, greenhouse construction, etc. April to October. (Noyes and Lurie)

8. ADMINISTRATION. Management of public parks, estates, cemeteries, public grounds, etc. A practical discussion from the administrative standpoint. July and September. (Ohlweiler)

9. MECHANICAL DRAWING. Lettering, geometrical drawing, projections, shades and shadows, perspective, architectural drawing. October to April. (Noyes)

10. FREE-HAND DRAWING. Pencil, charcoal and water color work, sketching of models, casts, flowers, trees, shrubs, etc. April to October. (Noyes)

Second Year

11. DENDROLOGY. Nursery work. Planting, growing, pruning, and care of trees and shrubs. Tree surgery. Fundamentals of forestry, including forest management, mensuration, protection, utilization, by-products, and wood preservation. October to April. (Lurie)

12. FORCING FRUITS AND VEGETABLES. Forcing of grapes, peaches, nectarines, figs, strawberries, pineapples, etc.,

under glass. Forcing of lettuce, tomatoes, cucumbers, melons, radishes, etc., under glass. January to April. (Lurie)

13. PLANT BREEDING. The principles and practice of plant breeding. Hybridization and selection. The origin of horticultural varieties. April to October. (Lurie)

14. PLANT MATERIALS. Flowering trees, shrubs, perennials, and annuals used in landscape designs and private gardens in this country. Intended to familiarize the student with the variety of flowering material at his disposal, together with the facilities of various nurseries and growers in America. April to October. (Ohlweiler)

15. SOILS. A consideration of the soil as a medium for root development and as a reservoir for the storage and conservation of water. Water movement, capillarity, aëration, temperature, natural minerals, soil organisms, etc. October to April. (Ohlweiler)

16. FERTILIZERS. Function of manure and commercial fertilizers, including a special study of nitrates, nitrites, phosphates, superphosphates, etc. A résumé of the present status of the subject with special reference to horticultural uses. October to April. (Ohlweiler)

17. AQUATIC GARDENING. Culture and use of aquatic plants. April to October. (Pring)

18. PURE DESIGN. Theory and practice; its application to all arts, especially landscape gardening. October to January. (Noyes)

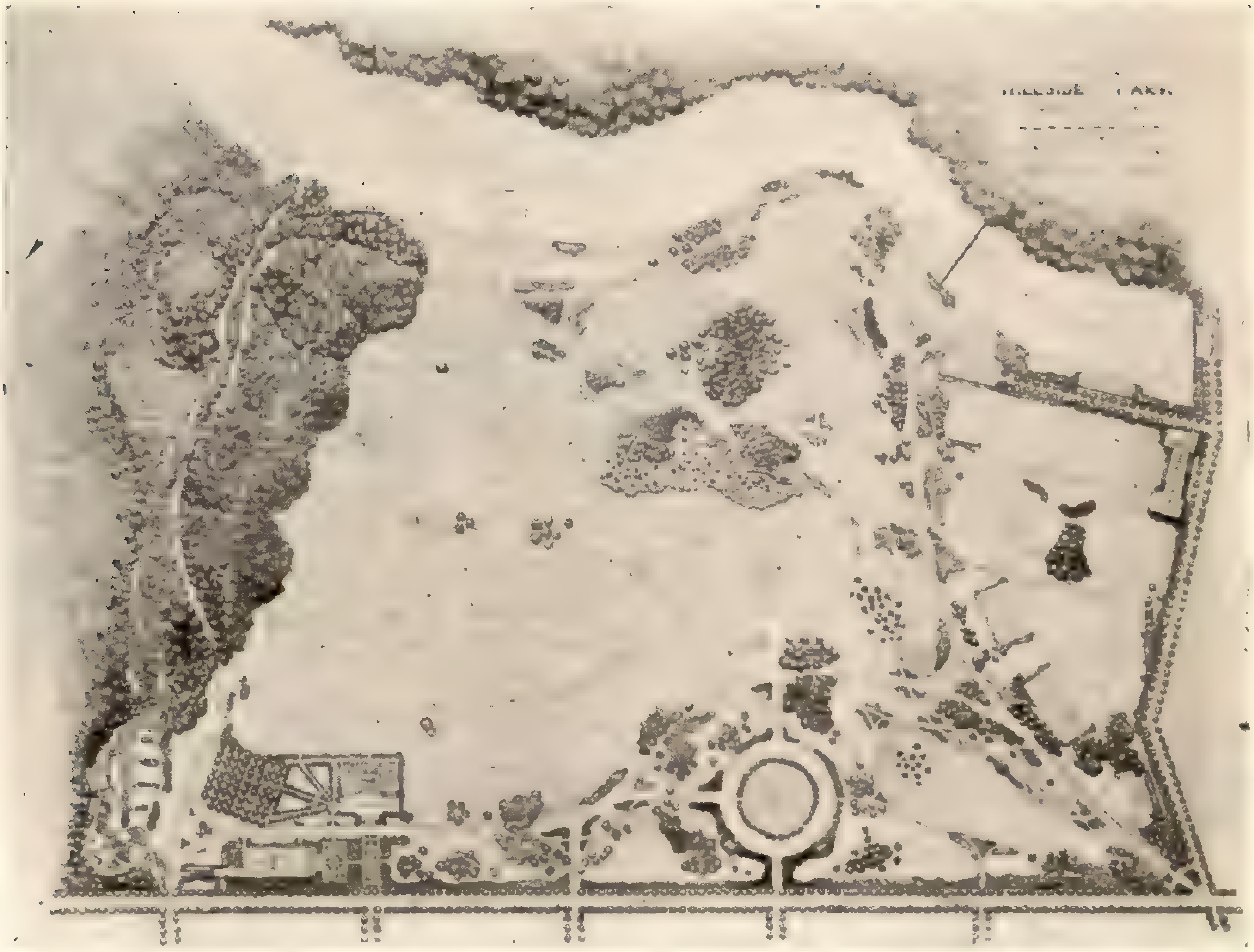
19. PRINCIPLES OF LANDSCAPE GARDENING. Lectures on history and theory. Practice in drafting, rendering in ink and water colors; office methods. Analysis of landscape designs. January to July. (Noyes)

20. LANDSCAPE DESIGN. Practice in design of home grounds, private estates, parks, playgrounds, cemeteries, subdivisions, etc. July and September. (Noyes)

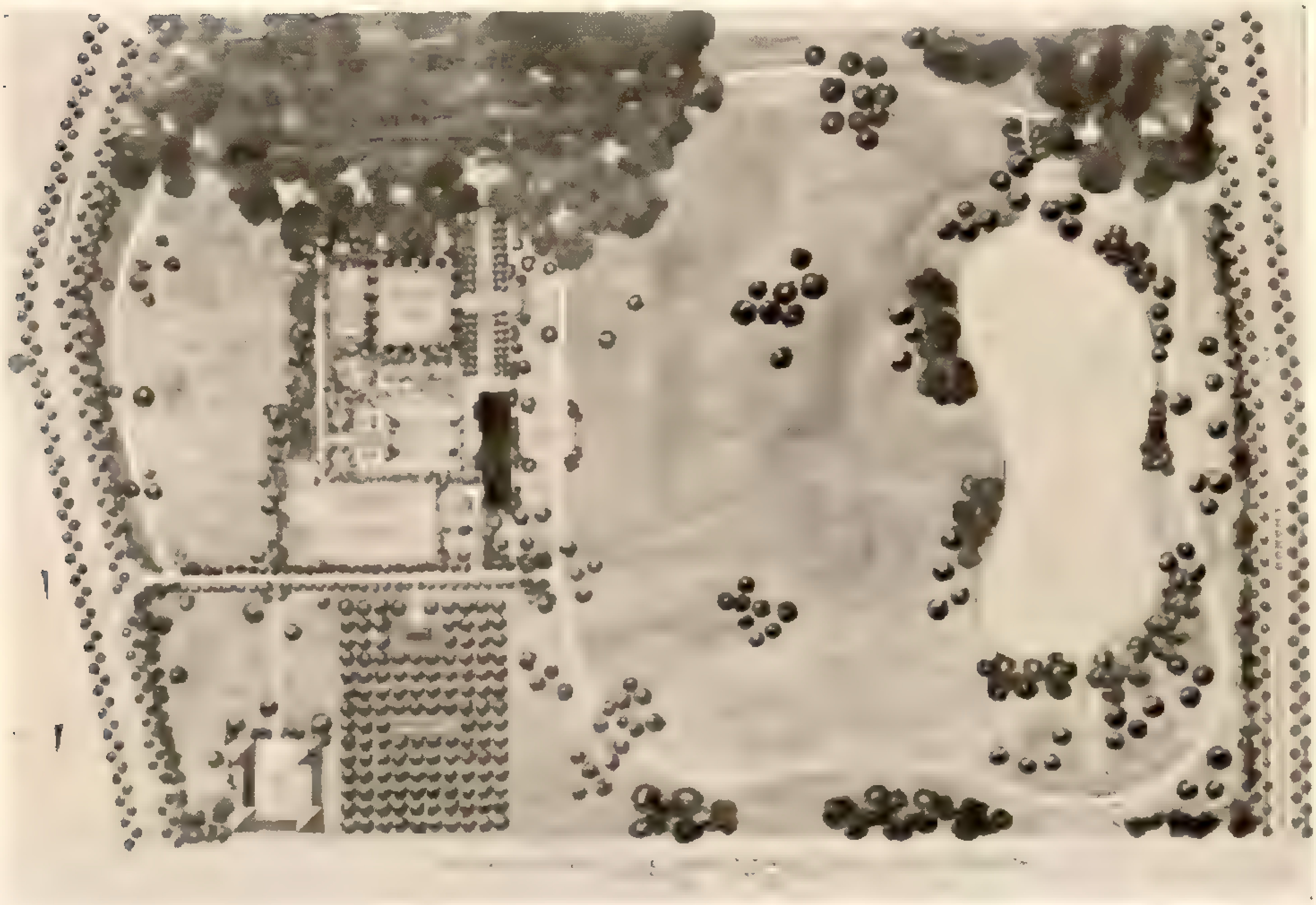
Third Year

21. PATHOLOGY. Laboratory work with lectures on the common diseases of greenhouse and other cultivated plants and trees. October to April. (Burt)

22. SYSTEMATIC BOTANY. Gross anatomy of plants, the study of the relationships between the various groups and individuals to be found cultivated and wild; designed primarily to train the student in the ready identification of plants. The period from January to March is devoted to the


HILLSIDE PARK

PARK DESIGN BY GARDEN STUDENT.



DESIGN OF AN ESTATE BY GARDEN STUDENT.

study of trees and shrubs in their winter condition. Making an herbarium. October to October. (Uphof)

23. Economic Botany. The uses of plants and their products; fibers, fruits, condiments, perfumes, medicinal plants, etc. April to October. (Pring)

24. Fruit Growing. A consideration of the various fruit areas of the United States, and of the climatic and topographical conditions influencing them; the location of orchards and fruit lands; windbreaks, tillage and moisture; planting schemes, harvesting, and marketing. April to October. (Lurie)

20. Landscape Design (*Continued*). October to January. (Noyes)

25. Planting Design. Study of harmony of color, form, foliage, etc., in plants for outdoor use; analysis of designs. Practice in planting design for various locations and purposes, for private estates, parks, city streets, flower gardens, etc. January to July. (Noyes)

26. Garden Architecture. Lectures on architectural styles and design. Practice in design of garden furniture, pergolas, arbors, summer houses, gates, entrances, etc. July and September. (Noyes)

27. Thesis. During the second year the student will choose or be assigned some definite problem leading out of the courses given, and in the third year he will be expected to pursue this topic with the intention of presenting a thesis covering the work done.

SCHEDULE OF AFTERNOON WORK

First Year

Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Oct. to Jan.	General Floriculture 2	General Botany 1	General Botany 1	Surveying 6	Mechanical Drawing 9	Special Work
Jan. to Apr.	General Floriculture 2	General Botany 1	General Botany 1	Surveying 6	Mechanical Drawing 9	Special Work
Apr. to July	Commercial Floriculture 3	General Botany 1	General Botany 1	Construction 7	Free-Hand Drawing 10	Disease Control 5
July and Sept.*	Commercial Floriculture 3	Special Work	Special Work	Construction 7	Free-Hand Drawing 10	Disease Control 5

Second Year

Oct. to Jan.	Soils 15	Dendrology 11	Systematic Botany 22	Pure Design 18	Pure Design 18	Special Work
Jan. to Apr.	Soils 15	Dendrology 11	Systematic Botany 22	Principles of Landscape Gardening 19	Principles of Landscape Gardening 19	Special Work
Apr. to July	Fertilizers 16	Plant Materials 14	Systematic Botany 22	Principles of Landscape Gardening 19	Principles of Landscape Gardening 19	Vegetable Gardening 4
July and Sept.	Fertilizers 16	Plant Materials 14	Systematic Botany 22	Landscape Design 20	Landscape Design 20	Vegetable Gardening 4

Third Year

Oct. to Jan.	Economic Botany 23	Fruit Growing 24	Plant Breeding 13	Landscape Design 20	Landscape Design 20	Thesis 27
Jan. to Apr.	Economic Botany 23	Fruit Growing 24	Plant Breeding Forc. Fruits 13	Planting Design 25	Planting Design 25	Thesis 27
Apr. to July	Thesis 27	Pathology 21	Aquatic Gardening 17	Planting Design 25	Planting Design 20	Thesis 27
July and Sept.	Thesis 27	Pathology 21 Administration 8	Aquatic Gardening 17 Administration 8	Garden Architecture 26	Garden Architecture 26	Thesis 27

* Vacation during August.

BOTANY

First year:

General Botany	9 months

Second year:

Systematic Botany	11 months

Third year:

Economic Botany	6 months
Pathology	5 months

ENGINEERING

First year:

Surveying	6 months
Construction	5 months

Third year:

Administration	2 months

HORTICULTURE

First year:

General Floriculture	6 months
Commercial Floriculture	5 months
Disease Control	5 months

Second year:

Vegetable Gardening	5 months
Dendrology	6 months
Soils	6 months
Fertilizers	5 months

Third year:

Forcing Fruits and Vegetables	3 months
Plant Breeding	6 months
Aquatic Gardening	5 months
Fruit Growing	6 months

LANDSCAPE ARCHITECTURE

First year:

Mechanical Drawing	6 months
Free-Hand Drawing	5 months

Second year:

Plant Materials	5 months
Pure Design	3 months
Landscape Gardening	6 months
Landscape Design	2 months

Third year:

Landscape Design	3 months
Planting Design	6 months
Garden Architecture	2 months

Scholarships.—Six scholarships, of the annual value of $350 each, are offered to students between the ages of sixteen and twenty years, possessing at least the education afforded by a regular high school course of recognized standing, or its equivalent. Since a scholarship may be reconferred upon the original recipient for two additional years, there are ordinarily but two scholarships to be awarded each year. All scholarships are awarded by a competitive examination held on the first Saturday in September, in the administration building of the Garden, Tower Grove and Botanical Avenues. Application blanks may be obtained at the Director's office and must be returned not later than August 15. Examinations are held in United States history, English literature, arithmetic, algebra, elements of botany and one other science (either zoölogy, chemistry, physics, or physiology) to be selected by the candidate, and one foreign language (either German, French, Spanish, Latin, or Greek) according to the training of the candidate.

Candidates who live at places remote from St. Louis may send, with their application, the name and address of the principal or a teacher in the nearest high school who will be willing to take charge of the examination. All applications of this character must be received by the Director not later than August 15. The charges for and place of holding such an examination must be a matter of mutual arrangement between the examiner and the student. The Garden in no way can assume the slightest responsibility for such matters.

Tuition.—In addition to those holding Garden scholarships, a few suitably prepared pupils will be admitted to the regular course at the rate of $50.00 per year. The charge for a single course of nine months, or more, is $15.00; for one of five or six months, $10.00; and for one of three months or less, $5.00.

Certificate.—Upon the satisfactory completion of the regular three-years' course and the passing of such examinations as may be required, a student shall receive a certificate from the Garden, indicating the work accomplished.

NOTES

Mr. A. J. Heinicke, of the Department of Pomology, Cornell University, is spending several days at the Garden consulting the library.

Dr. Norma E. Pfeiffer, of the University of North Dakota, spent the greater part of July at the Garden in connection with her monographic studies of the genus Isoetes.

Professor B. S. Brown, Head of the Department of Horticulture, University of Maine, and Mrs. Flora W. Patterson, Mycologist, Bureau of Plant Industry, U. S. Department of Agriculture, visited the Garden recently.

Mr. G. H. Pring, in charge of the conservatories at the Garden, lectured before the St. Louis Association of Gardeners at their June meeting on the "Development of Hybrid Nymphaeas."

Mr. Alexander Lurie, Horticulturist to the Garden, acted as judge of the Webster Groves school gardens on July 19. These gardens were under the supervision of Miss Clara Fuhr, one of the Garden students.

From June 22-30 the Garden students, accompanied by Mr. Alexander Lurie, made a tour of some of the large cities in a study of landscape gardening and horticulture. Indianapolis, Barberton, Akron, Cleveland, Detroit, Chicago, and Milwaukee were visited.

STATISTICAL INFORMATION FOR JUNE, 1917

Garden Attendance:	
Total number of visitors	28,131
Plant Accessions:	
Total number of plants and seeds donated	9
Total number of plants received in exchange	10
Plant Distribution:	
Total number of plants distributed in exchange	13
Library Accessions:	
Total number of books and pamphlets bought	10
Total number of books and pamphlets donated	44
Herbarium Accessions:	
By Purchase —	
Rev. John Davis—Plants of Missouri	225
John Kellogg—Private herbarium, consisting of plants of Missouri, Arkansas, Texas, California, etc., estimated at	12,000
Pedro Jörgensen—Plants of Argentina	342
Dr. L. O. Overholts—Fungi of Colorado	86
By Exchange —	
Gray Herbarium of Harvard University, by Dr. B. L. Robinson—"Plantae Exsiccatae Grayanae," Cent. II and III; Fredholm's Florida plants; miscellaneous duplicates	701
By Gift —	
J. A. Drushel—Plants of the United States	23
Dr. B. M. Duggar—Plants of Alabama	12
Dr. W. G. Farlow—Fungi from various localities	82
G. W. Hoffer—*Stereum purpureum* from Indiana	1
O. S. Ledman—Plants from Queen's Lake, Illinois	10
Prof. F. L. Stevens—Porto Rican fungi	3
By Field Work —	
Dr. J. M. Greenman—Plants of Illinois	37
Total	13,522

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

BENJAMIN MINGE DUGGAR,
Physiologist in charge of Graduate Laboratory.

EDWARD A. BURT,
Mycologist and Librarian.

HERMANN VON SCHRENK,
Pathologist.

J. C. TH. UPHOF,
Assistant Botanist.

JESSE M. GREENMAN,
Curator of the Herbarium.

KATHERINE H. LEIGH,
Secretary to the Director.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

JOHN NOYES,
Landscape Designer.

ALEXANDER LURIE,
Horticulturist.

A. B. MCINTYRE,
Outdoor Gardens.

W. F. LANGAN,
Engineer.

J. J. COUGHLIN,
Construction.

G. H. PRING,
Conservatories.

P. FOERSTER,
Farm and Stables.

M. SCHILLER,
Floral Displays.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. V AUGUST, 1917 No. 8

MISSOURI BOTANICAL GARDEN
1889

CONTENTS

Page

Native Wild Mushrooms for Food - - - - - 119

Books for Soldiers - - - - - - - - 129

Statistical Information - - - - - - - 130

ST. LOUIS, MO.
1917
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

BOARD OF TRUSTEES OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

Edward C. Eliot.
George C. Hitchcock.
P. Chouteau Maffitt.
Edward Mallinckrodt.
Leonard Matthews.
William H. H. Pettus.
Philip C. Scanlan.
John F. Shepley.

EX-OFFICIO MEMBERS

Edmund A. Engler,
President of The Academy of Science of St. Louis.

Frederic A. Hall,
Chancellor of Washington University.

Henry W. Kiel,
Mayor of the City of St. Louis.

Benjamin P. Stromberg,
President of the Board of Public Schools of St. Louis.

Daniel S. Tuttle,
Bishop of the Diocese of Missouri.

Roland W. Switzer, Secretary.

COPRINUS ATRAMENTARIUS.

Missouri Botanical Garden Bulletin

Vol. V St. Louis, Mo., August, 1917 No. 8

NATIVE WILD MUSHROOMS FOR FOOD

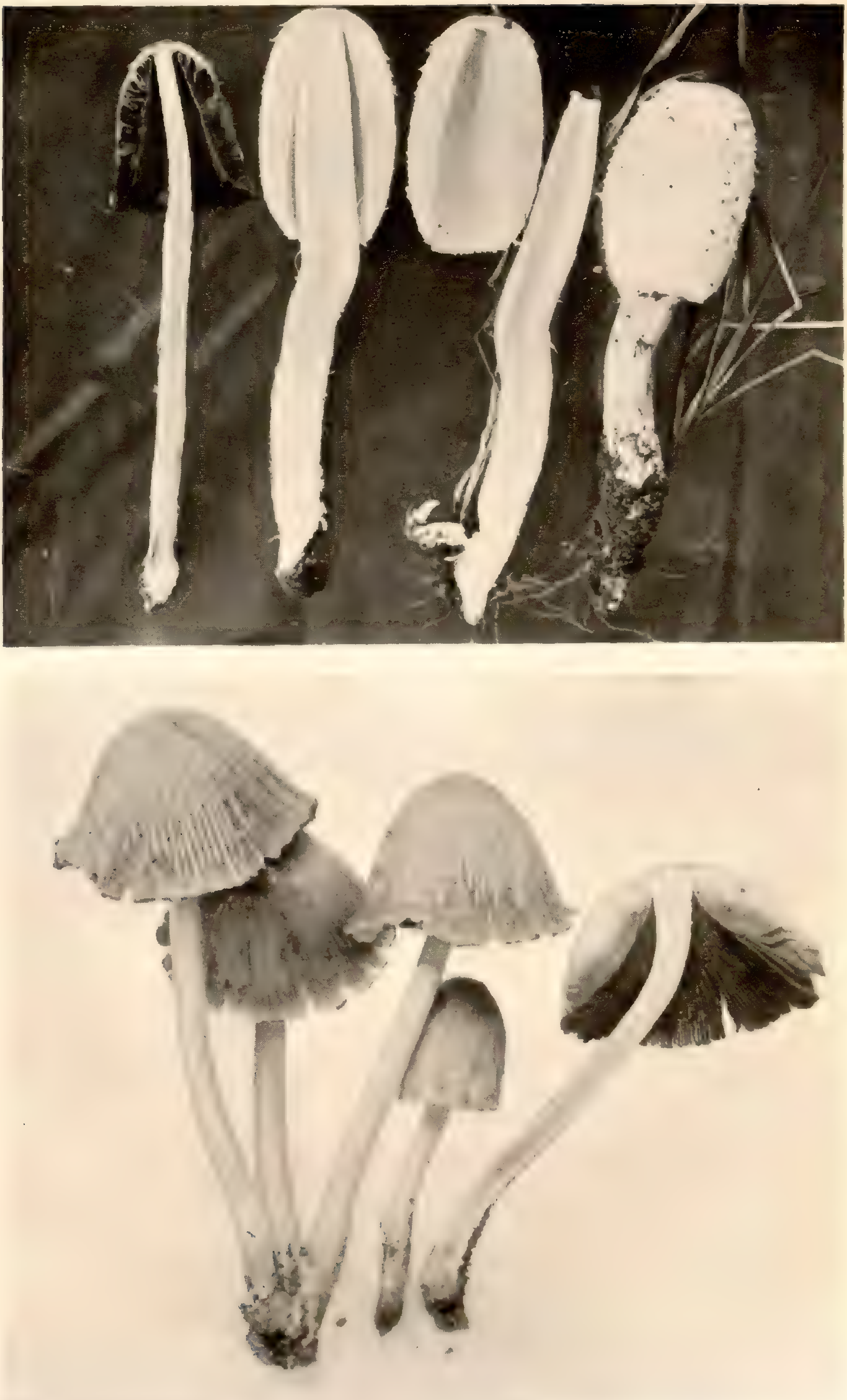
Even in normal times there is considerable discussion each season about the tremendous waste of good food in the failure to use the native wild mushroom crop. In the present crisis, with every element of the nation alert to the conservation of the well-known economic products and to the use of less appreciated ones, there is certain to be wide-spread interest, especially in the early fall, in wild mushrooms. Undoubtedly numerous inquiries will be made regarding the commoner species, and from past experience it may be inferred that the questions asked will be chiefly along two lines: (1) What are the desirable species, and how can one distinguish the edible from those which are inedible or poisonous? (2) What is the food value of mushrooms, and how may they be preserved?

It is a comparatively simple matter to state in general terms the food value of mushrooms and to discuss methods of conserving the surplus supply, but to give the layman or beginner an adequate idea of the innumerable species even in a single locality, and a method of distinguishing those which may be of greatest economic importance is by no means an easy task. It may be said at the outset that by mushrooms is meant not merely the cultivated form but any fleshy fungus whatever, wild or cultivated, good, bad, or indifferent as to edibility, and therefore including plants most diverse in size, texture, habit, and locality of growth. It is not practicable to divide these fungi into mushrooms and toadstools, but one may rather speak of them as edible, inedible, and poisonous mushrooms, depending upon their texture, flavor, and other properties. Not only those which grow on the soil will be considered, but likewise passing reference will be made to some representatives which will be found upon trees or upon decaying logs or timber.

Originally, of course, the edibility of any mushroom could only be determined by testing, so there is more or less foundation for the ancient joke that the way to tell a poisonous from a harmless species is to eat it. There thus were handed down by a sort of oral tradition certain facts about fungi as food which later became incorporated in various books on the subject. There has always been, however, a great demand for a simple infallible rule whereby the novice could distinguish edible from poisonous forms, and the silver spoon test (in which silver blackens from dangerous mushrooms and remains bright if the fungus is harmless) and the supposed fact that all edible varieties have a top or cap easily peeled, were made much of. Since the blackening of silver is due to the presence of protein-sulphur compounds which may occur in both the good and bad mushrooms, it has no value whatever, and other popular tests have been shown to be equally worthless. A moment's thought makes it obvious that any such rules are as impossible of application to mushrooms as to any other plant or animal, for that matter. Mushrooms are not in a mysterious class by themselves. One must distinguish the various species, just as one tells the wild fruits apart, namely, by knowing them; and unless one becomes familiar with at least the more common wild mushrooms it is impossible to tell with certainty the good from the bad. There is no need to know the thousands of species, for no one, not even the expert, can recognize them all at sight. However, to be able to accurately distinguish eight or ten forms is something, and to be familiar with fifty is to become almost an accomplished amateur.

Undoubtedly the easiest way to fix in the mind the characters by which mushrooms may be distinguished is to study them by groups, a few at a time, with the actual specimens at hand and with an illustrated book for a guide, or with the assistance of some one who is familiar with the various forms. In the following paragraphs brief and untechnical descriptions are given of a few of the commoner varieties, and assisted by illustrations it is hoped that these may be sufficiently suggestive to encourage the reader interested in mushrooms to make use of wider opportunities and more detailed information, such as may be obtained from members of the Garden staff or is available in the mushroom books and manuals which are to be exhibited at the Garden.

For the most part the mushrooms are members of one class of fungi, the Basidiomycetes, and this great group is subdivided into many families. There are five characteristic groups or families, namely, the Agaricaceae (gill fungi), the Polyporaceae (pore-bearing), the Hydnaceae



COPRINUS COMATUS.
COPRINUS MICACEUS.

(with tooth-like fruiting surfaces), the Clavariaceae (fairy clubs often much branched), and the Lycoperdaceae (puffballs). However, these rather formidable names need not discourage one, since in the vicinity of St. Louis there are not more than from one to a half dozen mushrooms in each group worth considering. In fact, the single family of gill fungi, or Agaricaceae, contains by far the greatest number of edible forms which are most apt to be collected.

AGARICACEAE

The agarics, or gill fungi, constitute the majority of familiar mushrooms. Although the forms and habits of these plants are diverse, it is possible to speak of a typical agaric, and this would be a plant of the parasol form, with central stalk and conspicuous cap. The under surface of the cap or pileus is studded with vertically placed radiating lamellae, or gills. They are the spore-bearing surfaces, and are usually more or less the color of the spores, which may be black (brown or purple-black), ochraceous, pink, or white, in the various genera or species.

The only satisfactory method of determining the color of the spores—which is important in the identification of the species—is to prepare a spore print. This may be done by breaking off the stem, placing the mature cap overnight on a sheet of white or black paper, and protecting from air currents; or the plant may be simply wrapped in paper which it is suspected will contrast with the color of the spores. Reference to any mushroom book used as a guide in determining species will show the importance of spore color. In addition, the identification of genera and species, in some detail, requires a close study of the method of attachment of the gills to the stem, the nature of the veil (or annulus) if any, the presence of a cup (volva), and many minor characteristics of stem, cap, gills, etc.

It will be possible here to consider only a few representatives of agarics with black spores and of those with white spores. If, however, the forms mentioned are carefully studied, one will have progressed far towards acquiring the confidence needed in using mushrooms as food.

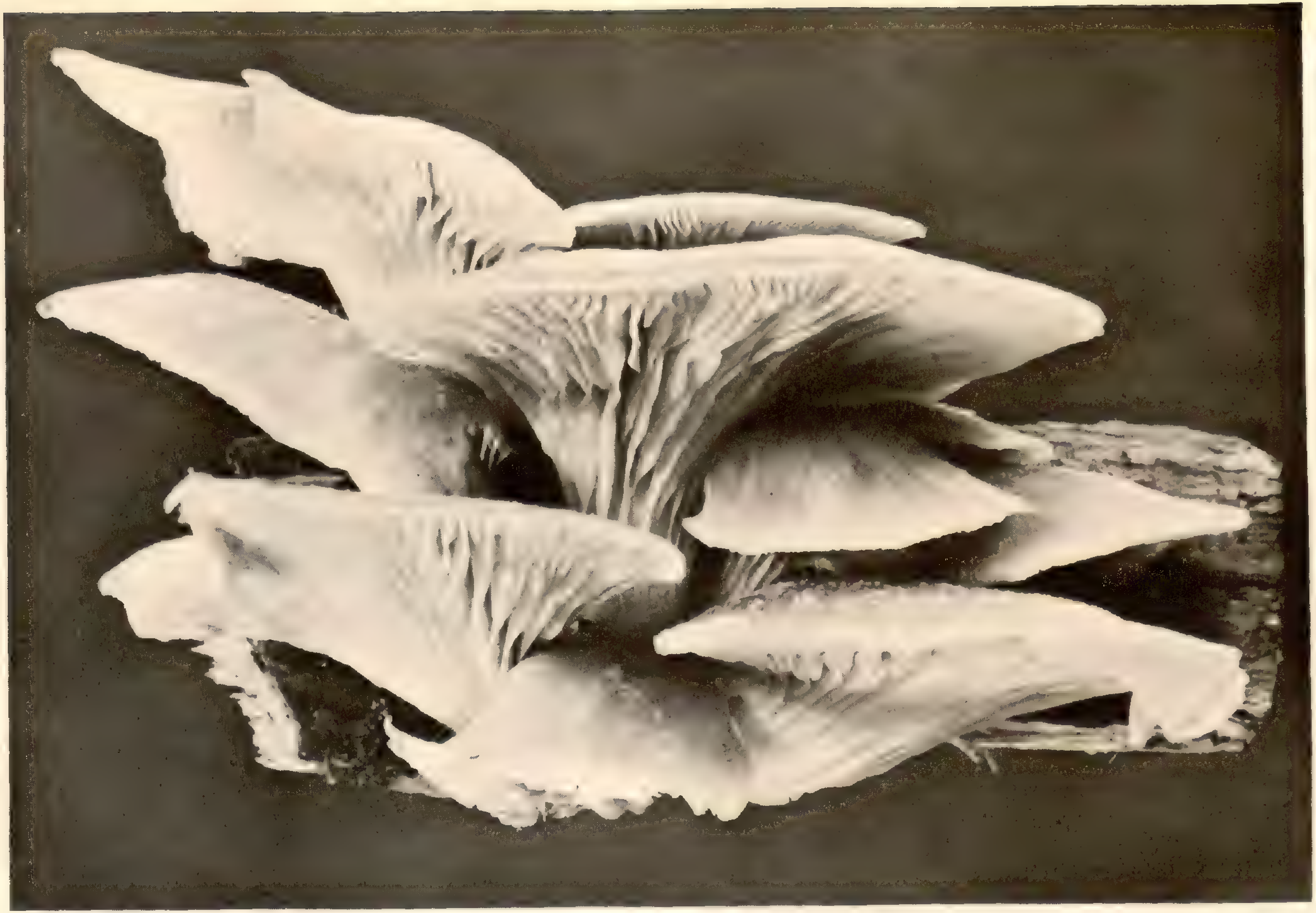
Agarics with Black Spores

For St. Louis and its vicinity three species of Coprinus (ink caps) are probably the most common wild mushrooms which are likely to be found from now until heavy frosts. Coprinus has gills which are whitish at first, then pinkish along the edge, then become gradually coal-black as the spores mature, and finally liquefy, beginning on the thin edges, so that an inky black fluid accumulates in drops on the gills as the latter melt away. Lawns are frequently discolored by such black inky drippings from species of Coprinus which have been permitted to go to waste. The liquefaction of the caps into a black fluid within a very few hours after maturity is a positive character by which the genus may be easily recognized. Its rapidly perishable nature excludes it from the markets, since the specimens become a total loss if not cooked within a very short time after being gathered. Species of this genus are a delicacy available only to those who know wild mushrooms. Because of its natural tendency to liquefy Coprinus is not well adapted for serving in the manner frequently used for the drier market mushrooms, but is preferable chopped fine in a cream sauce and served on toast.

The species of Coprinus which are referred to here have followed civilized man and are to be found on the land which he utilizes, very much as various grasses and other plants have accompanied him. They should be sought for on lawns where grass is kept short, rather than where it is permitted to grow up into meadows, and in low areas sometimes inundated, such as the pastures, thin woods, and bottoms about the Creve Coeur stop on the Missouri Pacific and Rock Island railroads. Do not mistake for Coprinus a small black-spored toadstool with cap about the size and form of an acorn, which is common on horse dung in pastures and also occurs scattered in highly manured lawns and pastures. This fungus, which has gills conspicuously mottled with black spores and a slender, straight, brittle stem, is a Panaeolus and produces an intoxicating effect. A species very similar to it, if not the same, has been known to cause severe poisoning when eaten in quantity. One should learn to recognize this small species, so that it may be at once rejected if found associated with edible forms.

Coprinus atramentarius is the species with lead-colored caps which grows in dense clusters of several individuals from a common underground source. Several pounds may be secured from a good cluster in a season, if the individuals are removed as they mature and care is taken not to injure young fructifications just starting at the surface of the ground.

Coprinus comatus grows on lawns as scattered individuals, or rarely, two or more together, and has an ovoid cap about once to twice the size of a hen's egg, more or less shaggy



PLEUROTUS OSTREATUS.

or fluffy on the outside, and white with a little yellow at the apex. This species is not as compact as the preceding.

Coprinus micaceus is a species buff to cinnamon-buff in color, one to two inches in diameter, with caps much thinner than the preceding species and more expanded, becoming convex. If held in a position favorable for reflecting the light, little mica-like scales may be seen on the upper surface of the caps, the name "micaceus" referring to these particles. *C. micaceus* has spores brownish black rather than the dead black of the preceding species; its fructifications are of a little drier consistency and hence do not liquefy quite as rapidly, but the gills melt away within a few hours after they begin to blacken. This species grows in clusters in the ground and is very partial to the vicinity of buried decaying wood and dying trees. The clusters are often gregarious on lawns in arcs of circles ten feet or more in diameter, forming the so-called "fairy rings" which may leave a lawn conspicuously discolored by their inky drippings if the crop is not harvested.

An individual of this species has but little substance; still even a few will impart their toothsome flavor to a dish prepared as above indicated, and a pint of their caps will suffice for a meal for a small family. *C. micaceus* is really a mushroom of merit, for it persists in the same spot for many years and produces successive crops through the whole season following each period of wet weather. A large cluster of this species by the remnants of a willow stump in a back-yard garden in St. Louis has for several years been as highly prized as an asparagus bed.

Hypholoma appendiculatum and *Hypholoma Candolleanum* are two lawn mushrooms having much the same color as *Coprinus micaceus* but found less frequently and in less abundance. They do not deliquesce upon maturity. Both are choice, edible species, and if they should be mistaken for *C. micaceus* there would be no harm done.

Agaricus campestris, commonly called the field or meadow mushroom, in some localities is found in quantity in favorable seasons during the cooler days of autumn. It is the chief wild mushroom sold on the market of American cities and is practically the only one cultivated, but it is by no means abundant in the vicinity of St. Louis. The plant has the typical agaric habit, and the general color of the upper surface is cream or smoky brown. It is fleshy, with a cap often three inches in diameter and a stout stem usually about equaling in height the diameter of the cap. The gills are pink when young, turning brown-black with age. There is generally a distinct ring attached to the stem above the middle. This ring is formed by the breaking of a "veil" which in earlier stages covered the gills, extending from the margin of the cap to the stem. Any one can readily become familiar with this species and, knowing it, may easily recognize related forms.

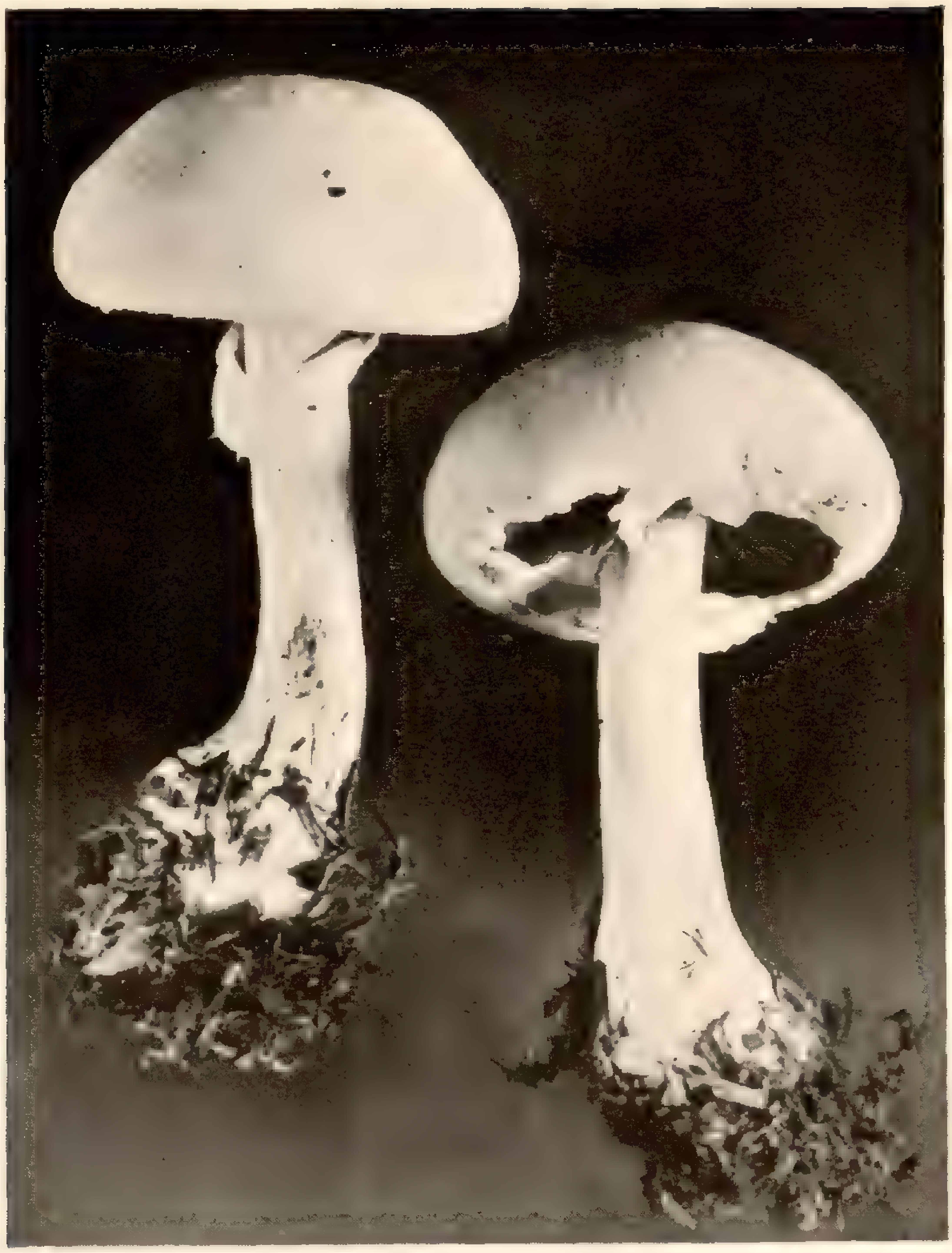
Agarics with White Spores

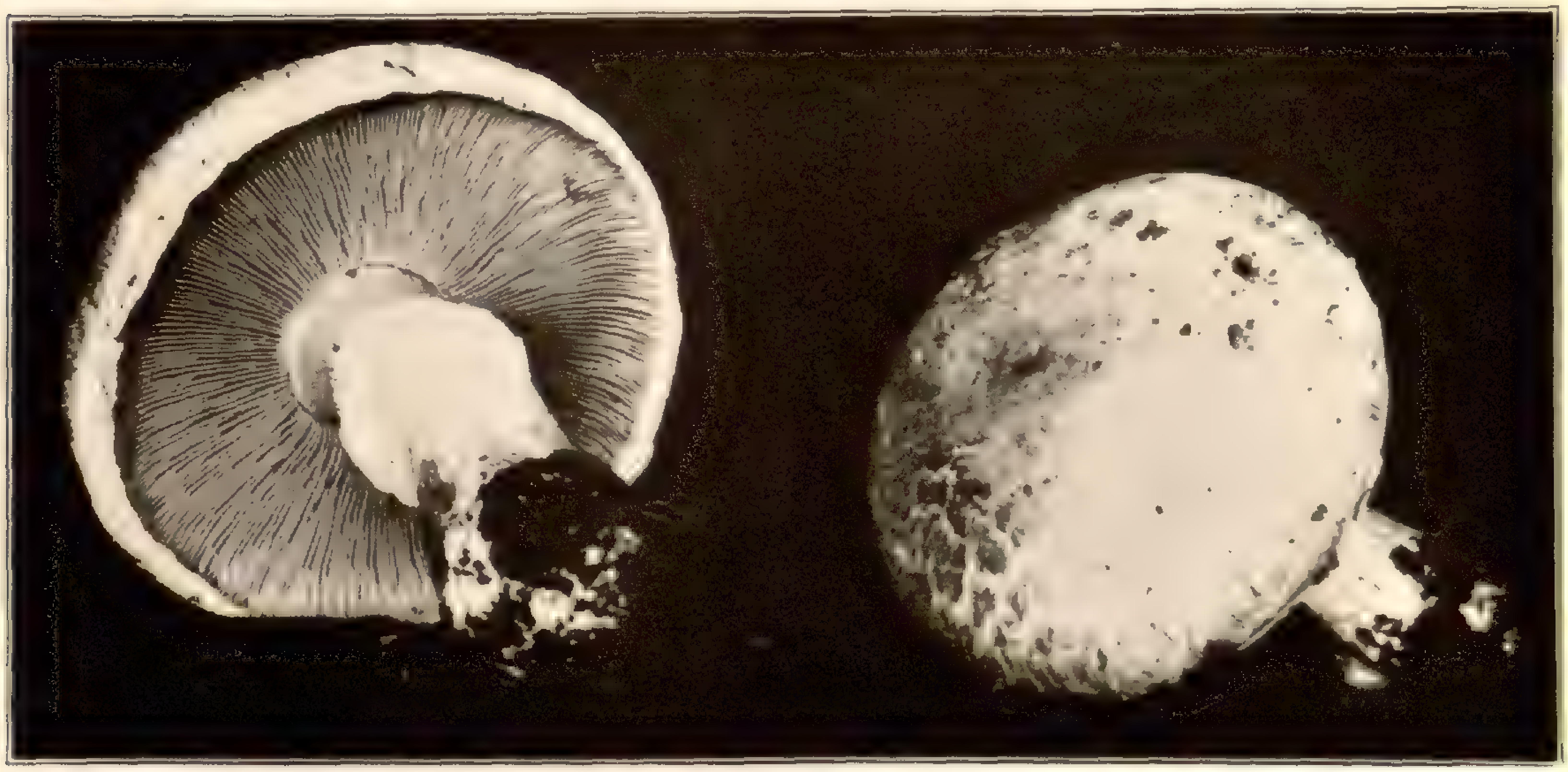
Among the numerous forms of this group which are eaten in various parts of the United States, only two genera occur about St. Louis in such abundance as to encourage the amateur to search for them.

Pleurotus ostreatus, Pleurotus sapidus, and *Pleurotus salignus* are edible species between which it is not necessary to distinguish. All three grow on the sides of rotting logs or trunks of dying deciduous trees, such as maple or willow. They are especially common in low woods which are sometimes inundated, like those at the end of Creve Coeur Lake towards Coleman. Any similar locality will afford just as favorable a collecting ground for these species, and fructifications may be frequently seen on dying trees in Forest Park and elsewhere in St. Louis.

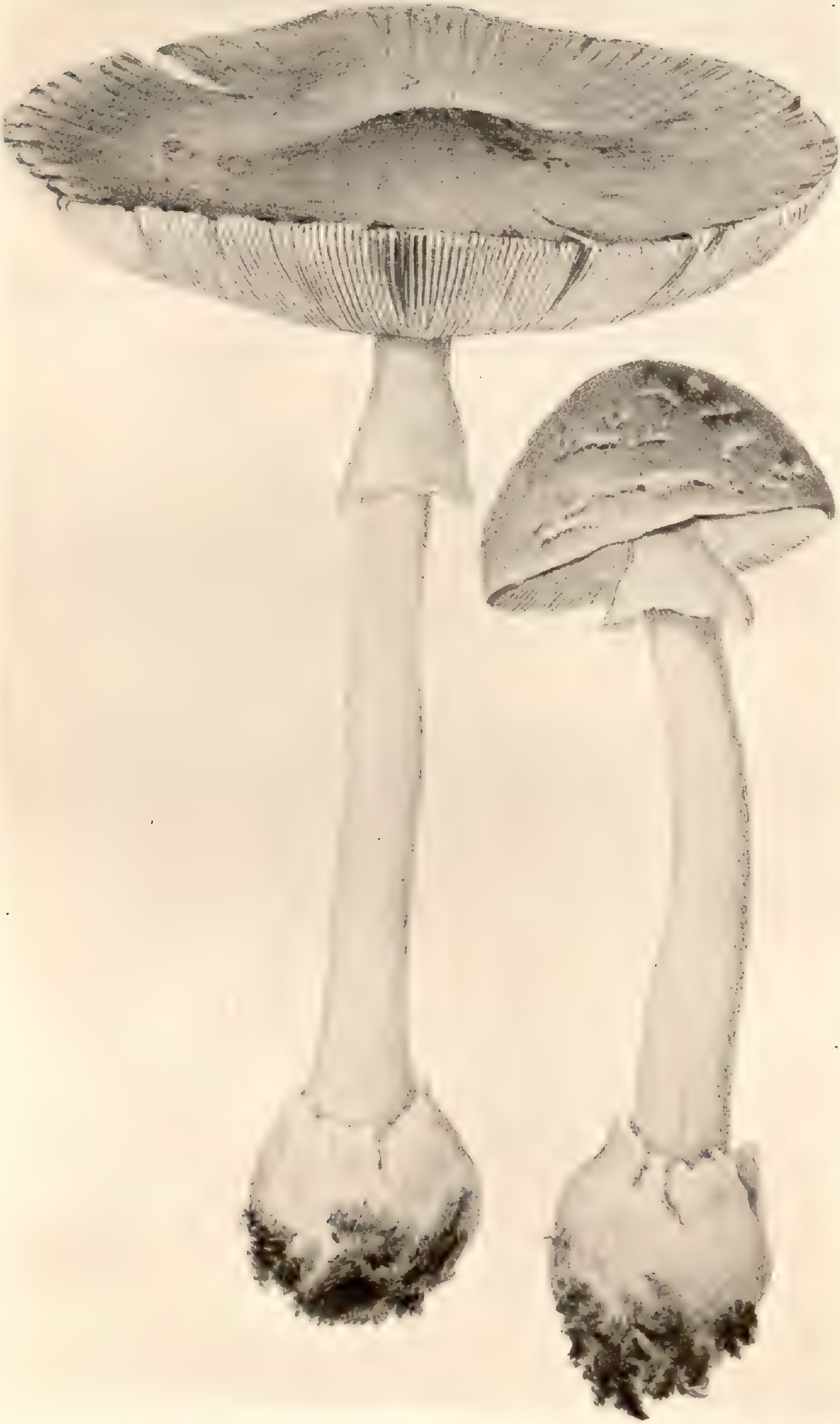
These species of Pleurotus lack a stem, that is, the cap is sessile, growing directly from the log or tree trunk. Furthermore, the cap is halved lengthwise and bracket-shaped, so that all gills of full length extend approximately from the tree trunk to the margin of the cap. The fructifications are large—from two to six inches broad—and often clustered together in an imbricate manner, with one fructification above another, making a mass of from one to several pounds. The caps are whitish, gray, and ashy to smoke-brown, but all have white gills and spores either white or slightly lilac. Pains should be taken to secure specimens which are not over-mature and yet fully grown. Young fructifications of fungi are never unwholesome in the sense that we regard immature fruit, but there may be considerable economic waste in harvesting young specimens which in perhaps 24 hours would double in volume and weight. Pleurotus is firmer than Coprinus and may be prepared for the table like the market mushroom.

Lepiota naucinoides is a white agaric with umbrella-shaped cap about three inches in diameter, rounded at the apex. It is more likely to be found in the fall in grass which has been allowed to become about six inches long rather than in that kept closely cropped. It has been collected abundantly in the vicinity of St. Louis, in corn fields





LEPIOTA NAUCINOIDES.
AGARICUS CAMPESTRIS.



AMANITA PHALLOIDES.

and similar cultivated areas. The gills are white at first and acquire in old specimens a slight pinkish tinge, but the spores are always white. The stem is white, tapering upward, and at about its middle or upper third passes through a membranous ring which is always present, no matter how young or old the specimen may be. Except for this ring, both the stem and the top of the cap have an absolutely even surface unbroken by scales, irregularities, or other outgrowths of any kind. There is likewise no trace of a bag-like membranous sack, termed the volva, which persists more or less completely at the surface of the ground and is so characteristic of the poisonous amanitas. Experienced persons, in gathering *L. naucinoides,* will always look for evidences of this sack on every specimen and will reject all those which have a volva or a scaly stem or cap. Specimens thought to be *Lepiota naucinoides* should be compared carefully with each detail of the preceding description, and if they conform in every particular, should be fixed in the memory so as to be recognized again, for *Lepiota naucinoides* is not only a choice edible mushroom of firmer consistency than a Coprinus but it is also a species of strategic importance, as its discovery and conquest leads easily to a similar end for two other important species, *Agaricus campestris* and *Amanita phalloides.*

Agaricus campestris, already referred to under black-spored forms, cannot usually be distinguished from *Lepiota naucinoides* when observed from above, but if removed intact from the ground it will be found that *Agaricus campestris* has a short stem nearly equaling its whole length in diameter and that the gills, although white at first and then pinkish, finally become brownish black. The character of the ring is also different.

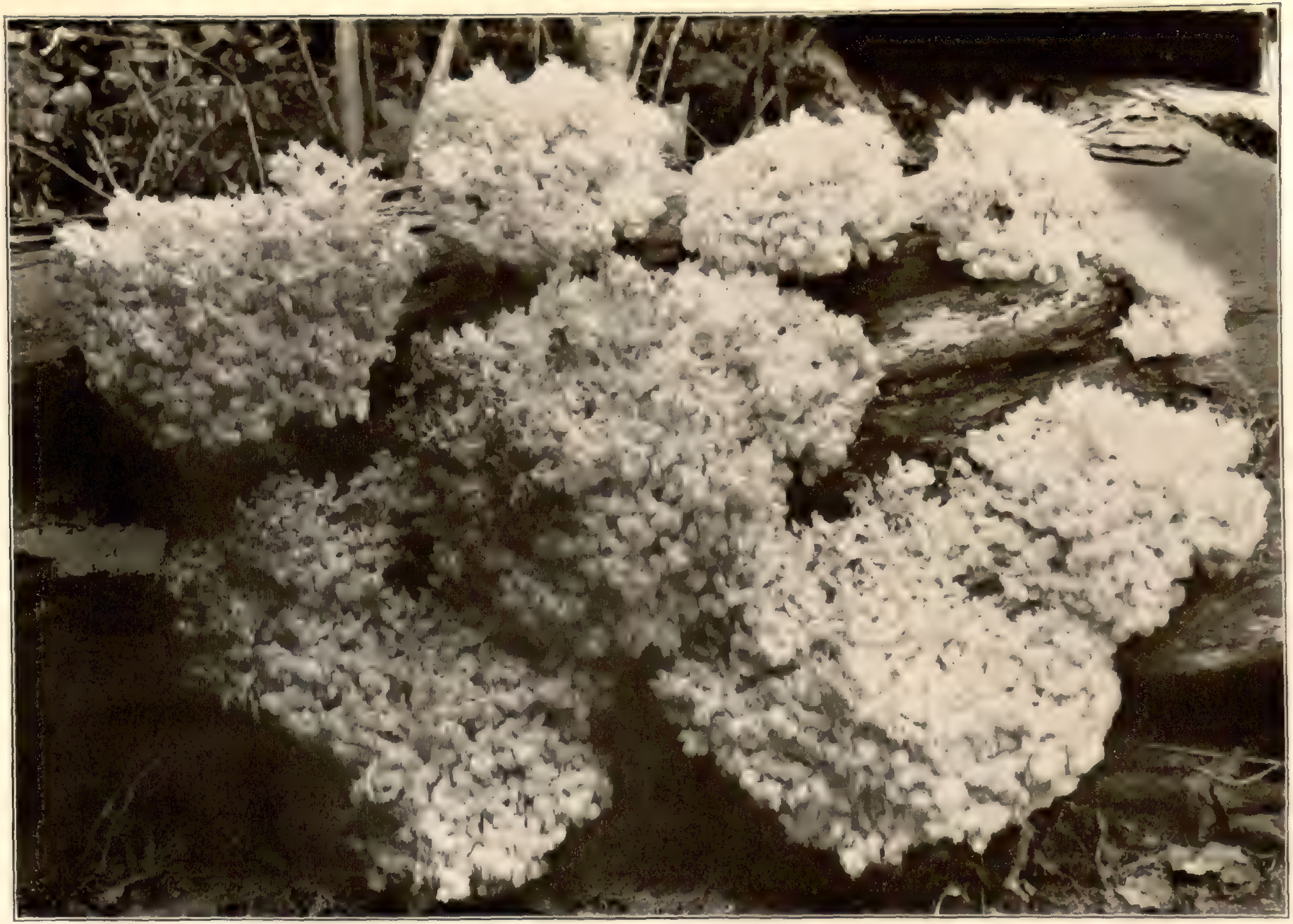
Amanita phalloides, the deadly Amanita, is the great menace to one who would like to eat wild mushrooms. To be sure it is not plentiful, but one experience with it is likely to prove the last. Fortunately this Amanita is easily recognized. Viewed from above it may closely resemble *Lepiota naucinoides* and *Agaricus campestris,* but if it is removed intact from the ground there will be found a membranous sack or volva attached to the stem at its very base, which in the early unexpanded "button" stage completely encloses the cap and stem. The presence of this so-called "poison-cup" is one of the most constant distinguishing characters of *Amanita phalloides,* consequently the importance of getting the entire stem of a white-spored mushroom — being sure that the base is not left in the ground—cannot be too strongly emphasized. The gills and spores of this Amanita are white. One should never gather specimens supposed to be *Lepiota naucinoides* or *Agaricus campestris* so rapidly or so inattentively as to overlook the presence of a volva at the base of the stem. The collection of "button" stages of *Lepiota naucinoides* is especially risky. There are one or two species of Amanita in addition to *A. phalloides* which are dangerously poisonous, but no mere printed description can be made explicit enough for an amateur to be positive concerning their determination. Any white-spored form about which there is the slightest doubt should be referred to a student of the group for identification before it is used for food.

POLYPORACEAE, HYDNACEAE, AND CLAVARIACEAE

The Polyporaceae or pore fungi possess, instead of gills, a fruiting layer consisting of minute tubes, the mouths of which appear as countless pores. Some representatives possess a central stem and characteristic cap but the great majority are of the stalkless, shelving type. The first-mentioned are mostly fleshy, while the latter are usually the tougher bracket fungi, punks, etc., found upon stumps, logs, and trees, and too hard to be used for food. The genus Boletus is the most important edible form, including many of the largest mushrooms of the type with a central stem. The cap is thick and fleshy, with a pore-bearing layer easily separable from the general tissue. The color of the cap is predominantly red-brown. In Europe *Boletus edulis,* a large species with gray-brown or red-brown cap and white or yellowish pore surface, contributes more to the wild mushroom food supply than any other species. More than 750,000 of this fungus were sold in the city of Munich in the late summer and fall of 1901, practically all being collected in the Bavarian woodlands of that general region. The variety is believed to have furnished the *fungi suilli,* or mushrooms for common people, of Roman times. *Boletus edulis* is not so abundant in the United States, but related forms may occasionally be found in and about St. Louis. The species of Boletus are numerous and several are to be shunned, so that none of the fleshy, pore-bearing fungi should be eaten until definite information concerning them is obtained.

In the Hydnaceae the fruiting surface is spread over spines or tooth-like structures instead of gills or pores. Some members of the group possess a central stalk and a true cap and perhaps the best of the edible species are of this character. In still other forms the definiteness of cap and stem are lost and the teeth are the main structures in

MO. BOT. GARD. BULL., VOL. 5, 1917.



HYDNUM CORALLOIDES.

evidence. While the Hydnaceae are found more or less abundantly in certain parts of the country upon decaying trees or logs in moist woods and meadows, they are not frequently obtained in this region. No injurious forms occur in this family and certain species are relished by some.

Members of the Clavariaceae are superficially not unlike certain of the Hydnaceae. These mushrooms are often club-like, much branched or coral-like in habit. They are mostly terrestrial species, often forming large clusters very attractive to the collector. There are no suspicious species and the more delicate branched forms are utilized.

LYCOPERDACEAE

The puff-balls differ materially in form and structure from other Basidiomycetes, and there can be no difficulty in recognizing them. They are usually spheroidal or ovoidal in form and when young almost invariably white and solid throughout. At maturity most of the tissues of the entire plant break up into a mass of colored spores and at this stage they take on the puff-ball or snuff-box condition, familiar in pastures, fields, and woods. There are a few small species with brown or black flesh which are not to be eaten, but as long as they are white and solid the puff-balls are all edible. When past their prime, as shown by the darkening of the interior, and infested with bacteria and insects, they should be discarded. Aside from *Agaricus campestris* and Coprinus, no other mushrooms are so much collected and eaten in the United States as the puff-balls. While not so pleasing in flavor as Agaricus, they are quite palatable and may be eaten without fear. A common form found in pastures, lawns, and meadows is from two to five inches in diameter, with a white or somewhat brownish or purplish colored exterior. The giant puff-ball is not infrequently 10–18 inches in diameter, of a pure white or cream color, appearing usually about the edges of woods or in meadows. Besides these two forms other smaller ones are frequent in woods.

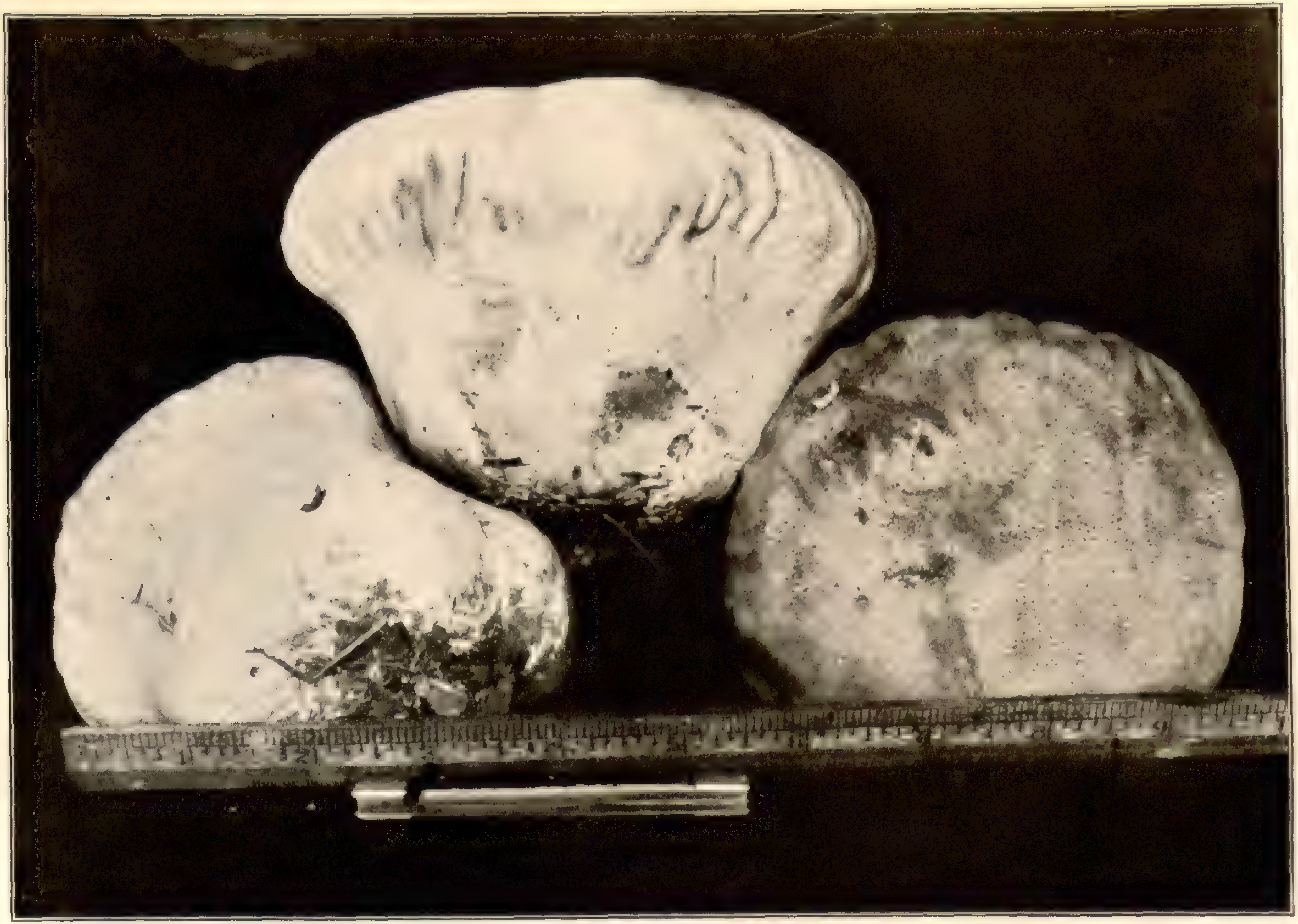
From the preceding discussion it is obvious that little or no difficulty will be experienced in avoiding suspicious forms in certain families, while in others one must proceed with the greatest caution in order to eliminate positively dangerous species. Fresh specimens of puff-balls with white meat, properly cooked, are wholesome and of good flavor, without any possibility of danger. Branched and toothed forms belonging to the Hydnaceae and the Clavariaceae are above suspicion but often not so delicate in texture or flavor.

The species of the liquefying Coprini described are highly commended, as well as the wild forms closely related to the cultivated mushroom. One needs only to be sure that no confusion with Panaeolus may result. On the other hand, the agarics with white spores must be carefully studied before selecting species to be eaten. Finally, among the pore-bearing species, the best forms of the fleshy Boletus have been utilized from the earliest times, but a knowledge of suspicious representatives of this group is essential.

Perhaps the best procedure for those desiring to collect mushrooms in the vicinity of St. Louis is first to learn the one or two positively poisonous forms likely to be found in this region; then become thoroughly acquainted with the six or eight—certainly not more than a dozen—edible species which are apt to be found in sufficient abundance to be of any real value. By sticking to the known varieties and never under any circumstances experimenting with doubtful forms, at least until they have been passed upon by an expert, many palatable additions to the routine diet may be made by the application of the knowledge obtained.

In order to facilitate the identification of wild mushrooms which may be found this fall in and about St. Louis, the Missouri Botanical Garden will place in the Museum building, located near the Cleveland Avenue gate, an exhibit of the more important books on the various edible and poisonous species of mushrooms. On Saturday mornings, from nine to twelve o'clock, some member of the Garden staff will be in the building to give information relative to the edibility of specimens of mushrooms which may be brought for identification. Mushrooms about which information is desired may likewise be sent by mail or by messenger to the Garden office at Tower Grove and Botanical Avenues, and a report will be furnished as to the name and edibility of the specimens, provided of course that they be received in a condition which will make determination possible. It will be necessary, therefore, to send specimens as promptly as possible and to use care enough in packing to prevent breaking or mashing.

The intent of this article is not to furnish a means of identifying all the various fungi which grow in this locality, since this would be worthless for most of the readers of the BULLETIN, even if the space could be devoted to it. But it is rather to call attention to the use of wild mushrooms as a cheap and appetizing addition to the daily ration, describing as accurately as possible a very few of the commonest local varieties. Should an interest



CALVATIA CYATHIFORMIS.

in mushrooms be aroused by this means, it is hoped that the facilities of the Missouri Botanical Garden will be used to the fullest extent in obtaining definite information as to the identity and edibility of the various forms which may be found.

FOOD VALUE AND PRESERVATION

With respect to food value there is another popular fallacy which mushrooms have inspired. They are often referred to as vegetable meat, animal-like, etc., all indicating or suggesting a high protein value, leaving one to conclude that they are as nourishing as meat. As a matter of fact, it has long been known that mushrooms have a food value about equal to the average green vegetable, and not nearly as great as potatoes and beans. It is true that the cultivated mushroom about equals the potato in protein content—not to discuss digestibility—but the carbohydrate content is much lower than that of the potato and approaches that of cabbage or spinach.

Mushrooms are to be thought of either as vegetables or as savory foods having a place as relishes or condimental dishes. The value of wild mushrooms must be considered from these standpoints. By using them one is able to vary the diet and to introduce unusual flavors. Besides being used alone and with meats, mushrooms fresh or dried may be used advantageously in soups, gravies, and sauces, also in combination with spaghetti and other starchy dishes.

Mushrooms may be canned by the methods employed with vegetables, some recommending the addition of a little lemon juice, say one teaspoonful with each pint of the product. Drying is, however, considered to be the most satisfactory means of preserving the majority of native mushrooms, and this is the prevailing method in Europe. Drying may take place in the sun or, in the absence of a drying outfit, in the half-open oven. A simple method consists in throwing cleansed plants on a wire mesh screen suspended above the stove. Fleshy forms may be cut into slices about one-fourth inch thick, and for convenience some prefer to store these. They may be stored in tin containers, preferably sealed with paraffine or odorless adhesive tape.

BOOKS FOR SOLDIERS

The American Library Association has been asked by the War Department to assume the responsibility for providing adequate library facilities in all cantonments and training camps. Special buildings will be erected for this purpose, and the library be opened for business when the cantonments and camps are ready. Thousands of books are needed at once to meet the requirements of officers and men.

The library of the Missouri Botanical Garden will undertake to receive and, as far as may be possible, collect books for this purpose, and, when a sufficient number is obtained, will pack and ship them to the proper authorities. Poorly printed, uninteresting, out-of-date books are obviously not worth shipping to the men. In addition to books of fiction, travel, history, etc., there is a demand for technical books on aviation, electricity, automobiles, first aid and hygiene, and any other subject likely to be of practical use to a soldier. Foreign language grammars and dictionaries, together with simple readers, are much needed, especially any dealing with the French language. It should be borne in mind that many of those who use the books will not have had great educational advantages and that consequently good books for boys and the less mature reader will be very acceptable. Recent magazines likely to prove attractive to the men at camp will also be received.

Books may be left at the main gate of the garden, Tower Grove Avenue and Flora Boulevard, or at the office building, Tower Grove and Shenandoah Avenues, and in case they cannot be delivered, by calling Grand 567, arrangements can probably be made for collecting them.

STATISTICAL INFORMATION FOR JULY, 1917

Garden Attendance:	
Total number of visitors	18,430
Plant Accessions:	
Total number of plants donated	9
Material Distributed:	
Vegetables to the Women's Central Committee on Food Conservation, bushels	10
Library Accessions:	
Total number of books and pamphlets bought	19
Total number of books and pamphlets donated	75
Herbarium Accessions:	
By Purchase —	
F. S. Collins—"Phycotheca Boreali-Americana," Fascicles XLIV and XLV, Nos. 2151–2250	100
Rev. John Davis—Plants of Missouri, etc	439
C. O. Levine—Plants of China	250
By Exchange —	
Bernice Pauahi Bishop Museum, by Dr. Charles N. Forbes —Plants of Hawaii	420

Gray Herbarium, by Dr. Sidney F. Blake—*Senecio* from Guatemala, collected by Mr. E. W. S. Holway	4
Gray Herbarium, by Mr. J. Francis Macbride—*Senecio exaltatus* Nutt. from Oregon	1
Philadelphia Academy of Natural Sciences, by Mr. Stewardson Brown—Plants of Delaware, collected by Mr. Albert Commons	451
U. S. National Museum, by Mr. Wm. R. Maxon—Plants of the Canary Islands, collected by Mrs. Alice Carter Cook	485
University of Texas, by Dr. Mary S. Young — Plants of Texas	126
By Gift —	
O. C. Charlton—*Eustoma Russellianum* (Hook.) Griseb. from Texas	1
Mrs. G. A. Deninga—*Hypericum punctatum* Lam., "spotted St. John's wort" from Missouri	1
J. A. Drushel—Flowering plants from United States	33
S. O. Hendrickson—*Calochortus Nuttallii* Torr. & Gray, the "mariposa lily" from South Dakota	1
I. M. Johnston — *Senecio ionophyllus* Greene, var. *sparsilobatus* (Parish) Hall from the San Antonio Mountains, California	1
O. S. Ledman—*Coreopsis sp.* from Missouri	1
Dr. W. H. Long—Merulius sp., destructive to logs of *Pinus edulis*	1
Dr. W. H. Long—Timber-destroying fungi of *Merulius* and genera of the *Thelephoraceae* from Texas, New Mexico, and Arizona	93
Royal Botanic Garden, Kew, England, by Sir David Prain, Director—Fragments of type specimens of *Merulius incrassatus* B. & C., *M. spissus* Berk., and authentic *Pellicularia Koleroya* Cke.	3
Henry S. Shaw—Specimens of *Verbena bracteosa* Michx. and *V. canadensis* (L.) Britt. from Bernie, Mo.	2
J. A. Stevenson—Fungi of Porto Rico	9
Wm. H. Temme—A form of *Trifolium repens* L. with proliferous inflorescence and sterile flowers	1
Dr. Herman von Schrenk — Plants from the herbarium of Prof. Joseph Schrenk, chiefly from New York	126
TOTAL	2,549

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

BENJAMIN MINGE DUGGAR,
Physiologist in charge of Graduate Laboratory.

HERMANN VON SCHRENK,
Pathologist.

JESSE M. GREENMAN,
Curator of the Herbarium.

EDWARD A. BURT,
Mycologist and Librarian.

J. C. TH. UPHOF,
Assistant Botanist.

KATHERINE H. LEIGH,
Secretary to the Director.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

JOHN NOYES,
Landscape Designer.

ALEXANDER LURIE,
Horticulturist.

J. J. COUGHLIN,
Construction.

P. FOERSTER,
Farm and Stables.

W. F. LANGAN,
Engineer.

G. H. PRING,
Conservatories.

M. SCHILLER,
Floral Displays.

H. VALENTINE,
Carpenter.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. V SEPTEMBER, 1917 No. 9

CONTENTS

	Page
Autumn Foliage	133
Plants in the Palm House	136
Notes	141
Statistical Information	143

ST. LOUIS, MO.
1917
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL,
AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF
THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

EDWARD C. ELIOT.

GEORGE C. HITCHCOCK.

P. CHOUTEAU MAFFITT.

EDWARD MALLINCKRODT.

LEONARD MATTHEWS.

WILLIAM H. H. PETTUS.

PHILIP C. SCANLAN.

JOHN F. SHEPLEY.

EX-OFFICIO MEMBERS

EDMUND A. ENGLER,
President of The Academy of Science of St. Louis.

FREDERIC A. HALL,
Chancellor of Washington University.

HENRY W. KIEL,
Mayor of the City of St. Louis.

BENJAMIN P. STROMBERG,
President of the Board of Public Schools St. Louis.

DANIEL S. TUTTLE,
Bishop of the Diocese of Missouri.

ROLAND W. SWITZER, Secretary.

Missouri Botanical Garden Bulletin

Vol. V St. Louis, Mo., September, 1917 No. 9

AUTUMN FOLIAGE

The prevailing color of the summer vegetation is green, and so closely do we associate this color with the foliage of vegetation as a whole, that we scarcely think of it as a color, but rather as the normal effect. Throughout most temperate regions of the earth, and particularly in North America and Europe, the onset of the autumn season initiates a riot of color in foliage with which, in favorable sections, there is nothing in nature to compare. Regarding these effects in central Europe it has been written: "What abundance of colour is then unfolded! The crowns of the pines bluish-green, the slender summits of the firs dark green, the foliage of hornbeams, maples, and white-stemmed birches pale yellow, the oaks brownish-yellow, the broad tracts of forests stocked with beeches in all gradations from yellowish to brownish-red, the mountain ashes, cherries and barberry bushes scarlet, the bird cherry and wild service trees purple, the cornel and spindle-tree violet, aspens orange, abeles and silver willows white and gray, and alders a dull brownish-green. And all these colours are distributed in the most varied and charming manner. * * * To be sure this splendour of colour lasts but a short time. At the end of October the first frosts set in, and when the north wind rages over the mountain tops all the red, violet, yellow, and brown foliage is shaken from the branches, tossed in a gay whirl to the ground, and drifted together along the banks and hedges." With modifications suitable to our own flora this description would hold remarkably well for the region about St. Louis.

While the autumn coloring of trees and shrubs in the Mississippi Valley region is scarcely equal to that of New England and the Appalachians, except during the most favorable seasons, it is always attractive and worthy of an analysis which may serve to relate effect and cause. Contrary to the popular belief, the change of color in the autumn season is not an index of death, but rather an indication of gradual maturity which may lead toward death. In general, the autumn colors may be classed as yellows and reds, although orange, brown, bronze, and purple may be found in the varied effects. The yellow and orange tints are due primarily to a group of pigments called xanthophyll, in reality, xanthophylls and carotins, while the reds are almost invariably anthocyanin. These names mean little more than the colors themselves until one discovers that there are extensive groups of plant pigments which have merited careful chemical and physiological study and classification.

Even the green leaves of the summer season exhibit sometimes a shade of yellow, and with a host of plants yellowing is associated with waning vigor and health. As a matter of fact, yellows are always present in the leaves, associated with the chlorophyll, or leaf green, so that when the conditions become unfavorable for the maintenance of health, the chlorophyll is broken down and the yellow pigments (in those plants which do not produce reds) become more conspicuous. These yellow pigments, like the chlorophyll, are not sap colors; moreover, they are more stable than the green, and may persist until the living cells are killed by cold. One of these yellow pigments, carotin, is also characteristic of many fruits, of certain mushrooms, and it is even found in various animal tissues.

In the vicinity of St. Louis yellow is the autumn color of the ginkgo among conifers, likewise of many species of willow, poplar, birch, and certain maples, also of box elder, mulberry, elm, hornbeam, chestnut, tupelo, and sycamore. It appears as an undertone where browns and reds are more prominent, as in the sassafras and horse-chestnut. The yellows in some foliage plants conspicuous in the summer season, as in certain varieties of coleus, are simply indicative of a preponderance of yellow pigment, veiling the leaf green but not excluding it.

The red pigments of autumn leaves are cell-sap colors, and nearly all such anthocyanins are soluble in the aqueous solution constituting the plant juices. It is significant that those plants exhibiting conspicuous red coloration in the autumn are often those which give indication of reddening with the first shoots of the spring growth. In this region there is no plant more loyal to autumn scarlet than the sumac, and in the spring the young shoots are reddened until the vigorous growth of warmer weather disperses the tint. Instances of this sort might be multiplied many fold.

In our own flora some species exhibiting pronounced reds are hard maple, sassafras, thorn-apples, sumac, dogwood, poison oak, Virginia creeper, and many others. Brown and purplish tones are often exhibited by hickory, persimmon, and ash. The vegetation that is suddenly cut off by severe frost seldom exhibits the best reds. Climatic influences are important, and it is clear that regions with a fairly high humidity and cool nights, as the autumn approaches, are those in which the highest coloration is attained. Nevertheless, similar pigmentation may be developed (in those plants capable of it) almost any season. In the middle of the summer a branch of hard maple or an isolated shoot of sumac may show high coloration. The heightened color is usually to be associated with some injury whereby the food materials manufactured in the leaves are not conducted away from the shoot or branch.

The production of anthocyanin in plants has been made the subject of much experimental study and careful analysis. It appears that the abundance of color in plants capable of producing it at all is related to the sugar content, and it also appears to be dependent upon oxidation phenomena. During the growing season the sugar produced in the leaves is rapidly utilized, but in the fall it is not required to such an extent in respiration, nor is it conducted away so freely. At the same time, the conditions are most satisfactory for the oxidation of the pigment mother substance, or chromogen. The pigment belongs to the group of substances chemically known as glucosides, containing glucose or fruit sugar as one constituent. It is interesting to note that twigs placed in a sugar solution, and under conditions otherwise favorable, have been found to redden conspicuously.

The red pigments of autumn coloring belong to the same group of substances as the pigments of red beets and purple grapes, of most red, purple, and blue flowers, and the red colors of such summer foliage plants as many varieties of coleus, begonia, croton, and the purple beeches and maples. In these last-mentioned foliage plants, however, the red color is distinctive of the variety or species practically throughout its period of growth, and it is developed so abundantly in the cell sap as to completely veil the chlorophyll. The simple experiment of plunging a red coleus leaf into boiling water for a few minutes is sufficient to demonstrate that the soluble red pigment is removable, and this removal makes visible in striking manner the green chlorophyll which is insoluble in water.

The landscape architect uses to advantage shrubs and other perennials which offer the possibility of autumn foliage colors, and likewise those—like the osier dogwood—whose twigs are reddened in the fall and remain brilliant for a considerable part of the winter. In the vicinity of St. Louis, where fall and spring effects are often those chiefly sought in the garden, the autumn coloration of leaves, fruits, and stems is a matter of special interest in the planning of the home grounds.

PLANTS IN THE PALM HOUSE

Acanthophoenix crinita. Palmae.—A medium-sized palm of Madagascar, attaining 50–60 feet in height. The leaves are 13 feet long, the petiole being covered with hairs and the sheaths with bristles.

Acanthophoenix rubra. Palmae. Prickly date palm.—A large palm of Mascarene Islands, reaching a height of 60 feet. The trunk and petioles of the leaves are covered with brownish spines. The leaves are 6–12 feet long. The plants are of decorative value in warm conservatories.

Archontophoenix Cunninghamii, Australia.

Acanthorhiza aculeata. Palmae.—A palm of Mexico, with robust stems densely clothed with the bases of dead sheaths, spiny at base. The leaves are terminal, deeply cut, glaucous below. The plant is used ornamentally.

Acanthorhiza Warscewiczii, Panama.

Acoelorrhaphe arborescens. Palmae.—A slender palm of North America, with fibrous bark and palmate leaves. It is used to a slight extent in conservatories.

Agathis loranthifolia. Coniferae. Dammar.—A tree native to the Malay Archipelago. It grows to a great height, and has nearly horizontal branches producing a whorl of smooth, leathery leaves. The wood is said to be like cedar, light and wholly unfit for exposure to the weather. It gives a resin called dammar, which as it flows from the tree is thin and viscous but hardens in a few days.

Allamanda Williamsii. Apocynaceae.—A bushy greenhouse shrub, native of South America. The leaves are long and narrow, usually in fours. The flowers are bright yellow, in continuous clusters, and fragrant. Its foliage and flowers make it valuable as an ornamental plant.

Alpinia nutans. Scitamineae. Shell flower.—An herbaceous plant of the East Indies, reaching a height of 12 feet. The leaves are glabrous, long-veined. The flowers are orchid-like, yellow touched with pink, sweet-scented, in long drooping racemes. The plant is used for its fine foliage and flowers. The roots are also used as a condiment, as a substitute for ginger.

Arenga saccharifera. Palmae. Sugar palm.—A tree 30–40 feet high, native of the Molucca Islands and the Philippines. It is one of the principal sources of palm sugar, or jaggery, this being obtained by boiling and evaporating the saccharine juice which flows upon wounding the young spadices. When fermented the juice yields toddy, or palm wine. When the trees have become exhausted by this wounding and bleeding the trunks are split and sago is obtained from the interior by scraping out the cellular contents, washing it, and granulating the starch. The tree dies after flowering.

Aspidistra elatior var. *variegata.* Liliaceae.—A popular conservatory and house plant from China. The foliage is stiff and shiny, with small inconspicuous flowers borne close to the ground. The plant is naturally fond of water, but will stand much abuse, dust and dry air, and lack of water and light. In rich soil the variegation disappears and the plants begin to starve, hence compost made of half sand is used.

Astrocaryum mexicanum. Palmae.—A spiny, stemless palm of Mexico, growing to a height of 6 feet. The fruit consists of a hard nut covered with a thin coating of pulp. The plant is often used in medium-sized conservatories.

Attalea Cohune. Palmae. Cohune palm.—A wing-leaved palm of Honduras, similar to cocoanut, but not attaining such a great height. The fruit is about the size of a turkey's egg and is produced in large bunches. The kernel tastes like a cocoanut but contains more oil of finer quality, this being pressed out and used for illuminating purposes by the natives. The trunk contains a great quantity of liquid which is obtained by cutting the tree down, making a hole near the top, and slightly raising the butt end so that the liquor flows into the hole. The supply lasts a long time and forms a cooling drink.

Attalea speciosa, Brazil.

Bactris major. Palmae.—A small palm, native of Brazil, reaching 15 feet in height. The stems are armed with long spines, which make the plants undesirable for ornamental culture.

Bambusa arundinacea. Gramineae. Bamboo.—A reedlike plant of India, attaining a height of 40–60 feet. The stems are produced in dense clumps, and are green and shiny, with spiny branches which are terminated with grass-like leaves. The flowers are produced at long intervals, and after perfecting seeds the plant dies. The wood is used for building purposes, water pipes, domestic utensils, fishing rods, etc.

Begonia nelumbiifolia. Begoniaceae. — A fibrous-rooted begonia, native of Mexico, used ornamentally in conservatories. The plant has a short, thick rhizome, with large peltate leaves, hairy on the under side. The flowers are small, white or pink.

Bignonia argyreo-violascens. Bignoniaceae. — A South American plant useful as an ornamental climber in greenhouses and outdoors in warm climates. It has cordate leaves, purple when young, later becoming veined and blotched with white. The flowers are purple.

Bignonia venusta. Bignoniaceae.—A woody climber of Brazil. It is a very profuse bloomer, having tubular flowers 2–3 inches long, crimson-orange in color.

Bignonia Clytostoma var. *callestegioides.*

Bougainvillea glabra. Nyctaginaceae.—A woody climber of South America. The leaves are dark green, glabrous, and the flowers are rosy red and distinctly veined. The plant is very ornamental, and is used extensively in conservatories.

Brahea calcarea. Palmae.—A spineless palm of Mexico, closely related to and resembling *Washingtonia filifera.*

Carludovica palmata. Cyclanthaceae. Panama-hat palm. —An important economic plant of South America. The leaves are palm-shaped and borne at the ends of long, slender stalks. They are gathered when very young and cut into narrow strips which are then steeped successively in boiling water, in water acidulated with lemon juice, and finally in cold water, and allowed to dry. When the bleaching is complete the strips are used for making Panama hats.

Carludovica latifolia, East Indies.

Caryota Rumphiana. Palmae. Fish-tail palm.—A native palm of Malaysia, remarkable for its fish-tail-shaped leaflets. After reaching maturity the plant begins flowering at the top and sometimes downward until the stem is exhausted. It is a useful greenhouse plant.

Caryota mitis (fish-tail palm), Malaysia.

Ceroxylon andicolum. Palmae. Wax-palm.—An ornamental palm, native of Colombia and Venezuela. The wax is naturally secreted on the stem, one specimen being said to yield as much as 25 pounds. The beauty of the palm is greatly enhanced by the white glaucous covering underneath the leaves.

Chamaedorea sp. Palmae.—A small palm with spineless, reed-like stems, native of Central America. The plant is quick-growing and suitable for greenhouse borders. The sexes are on different plants, therefore several should be planted in a group if the handsomely colored fruit is desired.

Chamaedorea bambusoides, Honduras. *C. corallina,* Venezuela. *C. Ernesti-Augusti,* Mexico. *C. oblongata,* Brazil.

Chamaerops humilis. Palmae.—A small, stemless palm of southern Europe and northern Africa. The plant ordinarily does not exceed 3–4 feet, but by suppression of suckers a stem is formed which attains a height of 20–30 feet. A tough fibre is obtained from the leaves which is used for making ropes, brushes, etc.

Chrysalidocarpus lutescens. Palmae.—A medium-sized palm of Madagascar. It is one of the most common of decorative greenhouse and house palms. The stems are yellowish dotted with black, several usually being produced from the same rhizome.

Cocos flexuosa. Palmae.—A slender, small palm of Brazil, growing to 12 feet in height. The leaves are finely cut. The plant is cultivated in greenhouses.

Cocos nucifera. Palmae. Cocoanut palm.—The cocoanut tree is widely cultivated in the tropics and grows near the sea-coast. It attains a height of 60–100 feet, with a cylindrical trunk from 1 to 2 feet in diameter, crowned with a number of feathery leaves. On the stem underneath the leaves are the bunches of cocoanuts, varying in number from 10 to 20. This is the most important of all the palms, owing to the various uses to which it is put. Aside from the nuts, the two most valuable products from the commercial standpoint are the dried kernels of the fruits, or copra, from which the oil is pressed, and the strong fibrous husk covering the nut, which is used in the manufacture of matting and ropes.

Cocos plumosa. Palmae.—A tall palm of Brazil, growing to a height of 50 feet. The stem reaches 1 foot in diameter, is ringed at intervals of a foot, and clothed near the apex with remnants of dead petioles. The leaves are 12–15 feet long, recurving. The plant is a quick grower and is used as an avenue palm in Florida and California.

Cocos Arechavaletana, Uruguay. *C. australis* and *C.* "Marie Rose," Paraguay. *C. Romanzoffiana,* Brazil.

Curculigo recurvata. Amaryllidaceae. Weevil plant.—A foliage plant of tropical Asia and Australia, with the habit of a palm and a curious floral structure. The leaves are gracefully arching and make the plant very attractive in greenhouses. If shade is given, the plant thrives outdoors in the southern states.

Daemonorops palembanicus. Palmae.—A native of Sumatra. The palm is slender, with pinnate leaves and spines upon the petioles. The imbricated scales covering the fruit become enveloped with a red, resinous coating. This furnishes a commercial substance used for coloring varnishes and in medicine as a coloring agent for plasters and tooth powders.

Dictyosperma rubra. Palmae.—A slender, spineless palm of India, used decoratively. The trunk reaches a height of 40–50 feet. The leaves are dark green with red primary veins and margins.

Dieffenbachia Seguine. Aroideae. Dumb-cane.—A native of the West Indies, having a fleshy cane-like stem 1½ inches in diameter and 4–6 feet high. The leaves are oblong elliptical, green with white spots. The plant is highly acrid and poisonous, and if chewed causes the tongue to swell and power of speech is lost for a time, hence the name dumbcane.

Dracaena fragrans var. *Massangeana.* Liliaceae.—An arborescent plant of South Africa, reaching a height of 20 feet. The leaves are shining, recurved, with a broad yellow stripe along the center. It is used chiefly as an ornamental conservatory plant.

Elaeis guineensis. Palmae. Oil palm.—A low-growing, wing-leaved palm of South Africa. The fruits are produced in dense bunches, each fruit being about the size of a date. An orange rind envelops a pulpy matter surrounding a hard nut, from both of which the palm oil of commerce is obtained. As imported the oil is about the consistency of butter, of orange-red color, with a sweet violet odor. It is used chiefly in soap- and candle-making. Glycerin is the principal by-product. Oil-cake made from ground kernels is used as food for cattle.

Erythea armata. Palmae. Blue palm.—A slender palm, 40 feet high, with very glaucous leaves. It is a native of California, where the trees are extensively used in gardens.

Erythea edulis. Palmae.—A spineless palm of California growing to 30 feet in height, with thick, corky bark. The leaves are pubescent.

Erythea Brandegeei, Lower California.

Ficus pseudopalma. Moraceae.—A native of the Philippine Islands, closely related to the commercial fig tree (*Ficus carica*). The trunk is slender, showing the scars of the long, narrow, coarsely serrate leaves.

Fittonia argyroneura. Acanthaceae.—An herbaceous perennial of Peru. The plant is valued greatly in conservatories for its large, heart-shaped leaves with white venation. It is trailing, covering banks and borders successfully, provided plenty of heat, moisture, and shade are afforded.

Fittonia gigantea. Acanthaceae. — A subshrubby, herbaceous perennial of Peru, used chiefly in conservatories for its foliage. The stems are reddish violet, and the leaves shining green with carmine veins.

Gaussia princeps. Palmae.—An ornamental, medium-sized, spineless palm from the West Indies.

Grias cauliflora. Myrtaceae. Anchovy pear.—A slender, unbranched tree of the West Indies, attaining a height of 50 feet, and terminated by a crown of smooth, elliptical leaves 2–3 feet in length. It has large, white flowers, which are produced on the stem below the leaves and are succeeded by large fleshy fruit.

(To be continued)

NOTES

On September 13 the delegates to the Nineteenth Annual Convention of the American Association of Park Superintendents visited the Garden.

On August 23 Mr. Alexander Lurie, Horticulturist to the Garden, judged the St. Louis thrift gardens under the auspices of the Women's Central Committee on Food Conservation.

The interesting dove or Holy Ghost orchid (*Peristeria elata*), described in the December, 1914, number of the BULLETIN, is now in bloom and may be seen in the orchid house during the next few weeks.

The Twenty-eighth Annual Gardeners' Banquet was held at the Mercantile Club on September 12, about 100 delegates to the Nineteenth Annual Convention of the American Association of Park Superintendents being special guests.

Mrs. Joseph Clemens, wife of Chaplain Clemens now in service in France, is spending some time at the Garden working on botanic collections which she has made in various parts of the United States, particularly in the Southwest.

Among the recent visitors to the Garden were Dr. Albin Stewart, Professor of Botany at the Florida State College for Women, Tallahassee, on August 20; Mr. F. J. Pritchard, of the Bureau of Plant Industry, U. S. Department of Agriculture, August 27; Dr. George M. Reed, Professor of Botany, University of Missouri, September 14; and Professor Stockton Axson, of the Rice Institute, Houston, Texas.

The third number of Volume IV of the Annals of the Missouri Botanical Garden has been issued with the following contents:

"Odontia Sacchari and O. saccharicola, New Species on Sugar Cane," E. A. Burt.

"The Thelephoraceae of North America. VIII," E. A. Burt.

"Algological Notes. I. Chlorochytrium gloeophilum Bohlin," G. T. Moore.

"Studies in the Physiology of the Fungi. V. The Growth of Certain Fungi in Plant Decoctions," B. M. Duggar, J. W. Severy, and H. Schmitz.

STATISTICAL INFORMATION FOR AUGUST, 1917

Garden Attendance:	
Total number of visitors	24,237
Plant Accessions:	
Total number of plants and seeds received in exchange	7
Library Accessions:	
Total number of books and pamphlets bought	8
Total number of books and pamphlets donated	68
Herbarium Accessions:	
By Purchase —	
Canton Christian College, by C. O. Levine—Plants of China	150
Prof. Aven Nelson—Plants of Alaska, collected by Mr. and Mrs. Ernest P. Walker	420
Prof. Aven Nelson—Plants of Idaho, collected by MacBride & Payson	907
By Gift —	
J. A. Drushel—Cultivated specimen of *Brauneria purpurea* (DC.) Britton, with proliferous inflorescence and sterile flowers	2
Dr. W. H. Emig—*Opuntia macrorhiza* Engelm., *Corphyranthe vivipera* (Nutt.) Britton & Rose, and *Echinocereus caespitosus* Engelm. & Gray from Oklahoma	3
Dr. J. M. Greenman—*Liatris cylindracea* Michx. from Meramec Highlands, Mo.	3
Dr. H. D. House—*Thelephoraceae* and other fungi of New York, collected by Dr. C. H. Peck	204
Dr. Henry Hertel—*Verbena urticaefolia* L. from Illinois	1
C. G. Lloyd—Fungi of Cuba	27
E. O. Matthews—*Aecidium Solani* on *Chamaesaracha Coronopus* (Dun.) from New Mexico	1
J. Matz—Pathogenic fungi of the fig and the pear	2
Dr. H. von Schrenk—*Coniophora cerebella* from New Jersey	1
Total	1,721

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2:00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

BENJAMIN MINGE DUGGAR,
Physiologist in charge of Graduate Laboratory.

EDWARD A. BURT,
Mycologist and Librarian.

HERMANN VON SCHRENK,
Pathologist.

J. C. TH. UPHOF,
Assistant Botanist.

JESSE M. GREENMAN,
Curator of the Herbarium.

KATHERINE H. LEIGH,
Secretary to the Director.

JAMES GURNEY,
Head Gardener, *Emeritus.*

WILLIAM W. OHLWEILER,
General Manager.

JOHN NOYES,
Landscape Designer.

ALEXANDER LURIE,
Horticulturist.

J. J. COUGHLIN,
Construction.

W. F. LANGAN,
Engineer.

P. FOERSTER,
Farm and Stables.

G. H. PRING,
Conservatories.

H. VALLENTINE,
Carpenter.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. V OCTOBER, 1917 No. 10

CONTENTS

	Page
Forcing Plants and Twigs	145
Plants in the Palm House	148
Lecture Course on the Development of a Small Place	154
Notes	154
Statistical Information	156

ST. LOUIS, MO.
1917
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

BOARD OF TRUSTEES OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

EDWARD C. ELIOT.

GEORGE C. HITCHCOCK.

P. CHOUTEAU MAFFITT.

EDWARD MALLINCKRODT.

LEONARD MATTHEWS.

WILLIAM H. H. PETTUS.

PHILIP C. SCANLAN.

JOHN F. SHEPLEY.

EX-OFFICIO MEMBERS

EDMUND A. ENGLER,
President of The Academy of Science of St. Louis.

FREDERIC A. HALL,
Chancellor of Washington University.

HENRY W. KIEL,
Mayor of the City of St. Louis.

RICHARD MURPHY,
President of the Board of Public Schools St. Louis.

DANIEL S. TUTTLE,
Bishop of the Diocese of Missouri.

ROLAND W. SWITZER, Secretary.

Missouri Botanical
Garden Bulletin

Vol. V St. Louis, Mo., October, 1917 No. 10

FORCING PLANTS AND TWIGS

The forcing of hardy herbaceous and woody plants has been practised for a number of years on a commercial scale, but it is not generally known that for home purposes, where forcing structures are not available, twigs of flowering trees and shrubs may be brought into bloom during the winter and serve to add a distinctive and unusual effect to home decoration. Before discussing the methods employed in forcing plants and twigs, it is essential to have a conception of their condition of dormancy or rest at the time of forcing.

The rest-period of plants may be defined as the time when all outward activities appear to be at a standstill. It usually begins in the fall with the advent of conditions unfavorable to growth and continues until these conditions are improved in the spring. In the case of deciduous trees and shrubs, the rest-period actually begins when the length growth ceases and the terminal buds form. This may take place as early as July, the plants gradually becoming more and more dormant until complete defoliation takes place. The herbaceous perennials begin to rest after their tops die down in the fall and crown buds are formed. Bulbs enter their dormancy within two to four weeks after flowering, when the tops yellow and die. The length of the period of rest varies with the different species; some are ready to begin growth in a few weeks; others are unable to start for several months.

The period of dormancy may be broken or shortened by means of various treatments. Plants with long rest-periods are difficult to arouse during the early stages, but the greater part may be readily forced during the middle portion of the period. Among the agents employed are ether, drying, freezing, submerging in warm water, immersing in weak alcohol, mechanical injuries, the use of weak solutions of hydrochloric and tartaric acids, etc.

Twigs of flowering shrubs, like lilac, golden-bell (Forsythia), deutzia, spiraea, may be forced into bloom in midwinter by submerging in warm water. A more satisfactory method, however, consists of placing the twigs in a tight container and pouring in ether at the rate of one teaspoonful to every 462 cubic inches of space. The plants should be allowed to remain in the vapor for 24 hours, and then be placed in water in a moist room. The moisture is essential to prevent the drying out of buds before growth starts.

Shrubs require special preliminary treatment if they are to be forced into successful bloom. It is absolutely necessary that vegetation be completely arrested and that the plants shall have entered into the period of complete repose. Unless this condition is observed, notwithstanding the best processes of forcing and the most improved equipment, the plants will develop leaves, but the flower buds will be blasted. In general practice, plants with a compact, fibrous root system should be selected, frequent transplanting in the nursery assuring this result. In addition, it is desirable to pot the plants in the spring and keep them plunged in soil during the summer. This will help ripen the wood more evenly and bring them into dormancy sooner. After a frost or two they should be placed in a cool house or cellar and kept at a temperature of 35° F. The plants will need no further watering if they are soaked thoroughly when stored.

There are actually three stages of the rest-period: the first, when parts of the plant cease growing; second, the complete repose; and third, the beginning of growth again. During the period of complete repose, in December, is the best time to begin forcing. A temperature of 45–50° F. in the greenhouse, with constant syringing to force out the buds will bring plants into bloom in 10–12 weeks. In the spring the time of forcing is shortened to 4–6 weeks. In order to hasten the growth ether may be used. Its effect is to shorten the rest-period of plants, probably by stimulation of exzyme action, and to cause a consequent quickening of growth. At a temperature of 60–65° F., during the early period of rest, one-half ounce of ether should be used per cubic foot of space. The amount should be decreased during the later stages of dormancy or if the relative humidity of the chamber is high. Care must be taken that the soil surrounding the plants is perfectly dry, as ether absorbs water and penetrates to the roots, causing injury and at the same time losing some of its efficiency because of the absorption of the vapor. The plants should be placed in an air-tight chamber, a small opening being left at the top for the insertion of a sponge containing the ether, this opening being afterward sealed. The time of exposure is variable, the usual time given being 48 hours, but decreasing late in the season. Sometimes a second exposure of 24 hours is made after a few days' interim. The treatment should always be given during the day, as artificial light may cause the mixed ether and air to explode.

The herbaceous perennials and biennials are forced in a manner similar to the shrubs, and may be planted in beds or potted after several frosts in the fall.

Bulbs are not forced successfully by means of etherization, because in practice they are gathered in late spring or summer and stored for months. After planting, the bulbs are allowed to remain in the cold-frame for a number of weeks, so that when brought into forcing conditions they are well over the rest-period.

The conclusions drawn from experiments and general practices are:

1. Etherization reduces the rest-period.
2. As a rule the greater the resistance of the dormant plant to growth under favorable conditions, the greater the advantage of etherization.
3. The value of the treatment is decreased as the end of the rest-period is approached.
4. Plants which respond readily to growth do not need any ether stimulation.
5. The expense of forcing is reduced in proportion to the length of time the plants occupy the greenhouses and the lower temperature necessary. An early market and better quality are also conducive to greater remuneration.

LIST OF PLANTS FOR FORCING

SHRUBS AND TWIGS

Botanical Name	Common Name
Azalea indica	
Cercis canadensis	Judas tree
Cydonia japonica	Japanese quince
Cornus florida	Flowering dogwood
Deutzia gracilis	Slender deutzia
Deutzia crenata	
Diervilla florida	Weigelia
Exochorda grandiflora	Pearl-bush
Forsythia viridissima	Golden-bell
Kalmia latifolia	Mountain laurel
Lonicera tatarica	Honeysuckle
Philadelphus grandiflorus	Mock-orange
Prunus triloba var. *plena*	Flowering almond

LIST OF PLANTS FOR FORCING

SHRUBS AND TWIGS

(*Continued*)

Botanical Name	Common Name
Pyrus floribunda	Flowering crab-apple
Rhododendron hybrids	
	Roses—numerous climbers and ramblers
Salix discolor	Pussy-willow
Salix humilis	Prairie willow
Salix Caprea	Goat willow
Spiraea prunifolia	Bridal-wreath
Spiraea Van Houttei	Van Houtte's spiraea
Syringa vulgaris hybrids	Lilac
Wistaria chinensis	Wistaria

HERBACEOUS PERENNIALS AND BIENNIALS

Achillea Ptarmica	White yarrow
Astilbe japonica	Spiraea
Baptisia australis	False indigo
Campanula pyramidalis	Canterbury bells
Delphinium formosum	Larkspur
Dicentra spectabilis	Bleeding-heart
Digitalis purpurea	Foxglove
Gaillardia grandiflora	Blanket-flower
Gypsophila paniculata	Baby's-breath
Pentstemon barbatus	
Platycodon grandiflorum	Balloon flower
Paeonia albiflora	Peony
Veronica longifolia	Speedwell

PLANTS IN THE PALM HOUSE

(*Continued from September Bulletin*)

Howea Belmoreana. Palmae. Curly palm. — A slender palm of Lord Howe Island, growing to a height of 35 feet. The leaves are 8 feet long, with numerous acuminate segments. This is a very popular plant for conservatory and house use.

Howea Forsteriana. Palmae. Flat-leaf palm.—An erect, spineless palm of Lord Howe Island. This is one of the most popular of the house palms and is grown commercially by the thousands. It is similar to *H. Belmoreana,* but the leaves are hanging instead of converging upward as in the latter species.

Hydriastele Wendlandiana. Palmae. — A tall palm of Australia, with very long pinnate leaves. It is used ornamentally in conservatories.

Hyophorbe Verschaffeltii. Palmae.—A spineless, ornamental palm of Mascarene Islands, with long, pinnate, arching leaves. This is a fine plant for conservatories.

Jubaea spectabilis. Palmae. Coquito nut.—A wing-leaved palm of Chile, resembling a date palm. The stem contains a sugary sap which, when the tree is felled and the leaves closely cut off, begins to flow and continues to do so for several months. The sap is then boiled and used as a substitute for sugar.

Kentia Macarthurii. Palmae. — A fine palm of New Guinea. It is attractive in conservatories because of its feathery foliage with arching leaflets.

Kentia Sanderiana. Palmae.—A very graceful plant of Molucca Islands, suitable for conservatories and jardinieres. It is a very slender palm, with hard foliage and narrow leaves arranged on an arching rachis similarly to *Cocos Weddelliana.*

Latania aurea. Palmae. — A native palm of Rodriguez Island, with pale green leaves 4–5 feet long.

Latania Commersonii. Palmae.—A tall, spineless palm of Mascarene Islands. The stems are robust, with large terminal leaves, the margins and veins of which are tinged red. This is one of the best-known conservatory palms.

Latania Loddigesii. Palmae.—A very ornamental palm, native of Mauritius. It is tall and spineless, with very glaucous leaves tomentose beneath and tinged with red.

Licuala grandis. Palmae.—A small, erect palm of New Britain Island, used ornamentally in conservatories. The leaves are numerous, erect, fan-shaped, spreading, with spines along the margins below the middle.

Livistona australis. Palmae. Cabbage palm.—A large, fan-leafed palm, native of Australia. The stem is very soft and fibrous, and the central portion, when young and fresh, is said to be eaten by pigs. Fibre is obtained from the leaves which is used by natives for making hats and belts.

Livistona chinensis. Palmae.—A native palm of China, used extensively as an ornamental conservatory plant. The stems are 6 feet high, more than 1 foot thick, gray, and ringed. The petioles of the leaves are covered with brown spines. The leaves are round, fan-like, reaching 4–6 feet in diameter.

Livistona rotundifolia, Java.

Martinezia caryotaefolia. Palmae.—An ornamental palm of Colombia, with a spiny, ringed trunk reaching a height of 30–50 feet. The leaves are few, 3–6 feet long, and resemble those of the fish-tail palm. This species makes a good house plant.

Monstera deliciosa. Aroideae.—An epiphytic climber of Mexico. The stems are about 1 inch in diameter, extending to a great length and bearing large, perforated, cordate leaves. The fruit is pink, about the size of a small pineapple, pulpy, and of a delicious flavor.

Oreodoxa regia. Palmae. Royal palm. — A tall palm, native of the West Indies, where it is used chiefly as an ornamental plant. When cultivated the trunk becomes clothed with a glaucous covering which renders the plant very picturesque. The palms of the celebrated Royal Palm Avenue in the Botanical Gardens, Rio de Janeiro, are of this species.

Pandanus caricosus. Pandanaceae. — A shrub of the Molucca Islands. The leaves are 5–8 feet long, narrow, slightly glaucous, with minute white spines.

Pandanus utilis. Pandanaceae. Screw pine.—A peculiar plant of Madagascar, attaining a height of 60 feet. The plant has thick, stilt-like, aerial roots which lift the trunk out of the ground and anchor the tree. The branches are few, scarred, naked, crowned by a tuft of leaves spirally arranged. The leaves are sword-shaped and spiny and are made into mats, baskets, hats, etc. The roots consist of a tough, spongy fibre, which, when cut into lengths and beaten out at the end, form brushes. The young plants are used for decoration on account of the glossy, graceful foliage.

Pandanus Veitchii. Pandanaceae. Screw pine. — An ornamental plant from Polynesia. The species is similar to *P. utilis* except that the spiral growth is not as pronounced and the leaves are dark in the center margined with bands of white.

Philodendron sagittifolium. Araceae.—A shrubby plant with climbing stems, native of South America. The dark green, triangular foliage is very attractive.

Phoenix canariensis. Palmae. Canary Islands date.—A stately avenue palm of the Canary Islands. The trunk is very large, reaching 3 feet in diameter at the age of 8–10 years. The leaves are 12–15 feet long, with a spread of the crown averaging 30 feet in diameter. The palm is very symmetrical and is used extensively in Florida.

Phoenix dactylifera. Palmae. Date palm.—A tree 40–50 feet high, distributed over southern Europe, northern Africa, and southeastern Asia. In northern Africa and the Sahara

Desert the fruit serves as the most common food not only for the natives but also for the cattle, while the huts and the houses are constructed from the wood of the tree. The culture of the date runs back to antiquity. It was emblematic of the Jewish people, Jerico being known as the city of palm trees. The plant is remarkable for its endurance of conditions that make most crop plants impossible. It will thrive in alkaline soil so salty that no other crop plant can grow, and will stand a slight frost. The yield of fruit from a single tree reaches as much as 130 pounds. Commercial growing of the trees is being attempted in the desert regions of the southwestern United States.

Phoenix paludosa. Palmae.—A reclining palm growing to a height of 25 feet, native of the sea-shore of tropical Asia.

Phoenix pumila. Palmae. — A slender, graceful palm 6–10 feet high, with leaves 10–16 feet long, recurved, drooping.

Phoenix reclinata. Palmae. — An ornamental palm of tropical South Africa. The stems are 3–4 feet long and reclining. The fruits are black and edible.

Phoenix Roebelenii. Palmae. — A native of India and the most used by the florists as a decorative plant among the Phoenix. The stems are short, tufted with subglaucous leaves. This is the smallest of the Phoenix and is exceptional for the elegance and soft texture of the bright green leaves.

Phoenix rupicola. Palmae.—A native of Sikhim, India. The stems are 15–20 feet high, solitary, slender, with glabrous leaves 10 feet long. The numerous bright green, decurved leaflets are peculiar to this palm. It will stand the hottest sunshine without losing color and will bear much neglect when used as a house plant.

Phoenix sylvestris. Palmae. — A native palm of India, where it reaches a height of 40 feet. Sugar is obtained from the evaporation of the sap which flows from incisions made in the upper part of the trunk. The process does not destroy the palm, the sap being drawn for 50 years. A kind of arrack is made by the fermentation and distillation of the sap. The leaves are used for mats.

Pithecoctenium muricatum. Bignoniaceae.—A climber, native of Mexico. The plant is cultivated for its racemes of large trumpet-like, white flowers.

Pritchardia Gaudichaudii. Palmae.—A spineless palm of the Hawaiian Islands, reaching a height of 20 feet. The leaves are rounded, 3–4 feet long, covered with pale brown matted wool, and slit for about 1 foot into 60 segments.

Pritchardia Martii. Palmae. — A spineless fan-palm of the Hawaiian Islands, used as a conservatory plant and cultivated in southern California. The trunk generally does not exceed 6 feet. The leaves are 3–4 feet long, glabrous below.

Pritchardia pacifica. Palmae.—A native of Fiji Islands, growing to a height of 30 feet. The palm is remarkable for its fluffy, fibrous leaf-stalks. The leaves are rounded, deeply cut, 4½ feet long, and pliant.

Ptychosperma elegans, Australia.

Ravenala madagascariensis. Musaceae. Travelers' tree. —A native of Madagascar, with a cylindrical stem 1 foot in diameter and 30 or more feet in height. The leaves are broad, similar to the banana (*Musa Ensete*) but set in two rows. Rain-water is held in considerable quantity within the leaf-sheaths and if these are pierced the water gushes out like a jet. On this account the plant has received the appellation of travelers' tree. The stems are used for house building, making durable floors. For this purpose they are split in halves and the convex side placed uppermost, this soon flattening down and becoming extremely hard.

Rhapis flabelliformis. Palmae. Rattan.—A dense, low-growing palm, native of China and Japan. The long, rod-like growths afford the rattan cane of commerce.

Rhapis humilis. Palmae.—A small fan-palm of China.

Rhopalostylis sapida. Palmae.—A pinnate palm of New Zealand, attaining a height of 10 feet. The leaves are 4–6 feet long, pinnate, with narrow segments.

Roystonea (*Oreodoxa*) *Borinquena.* Palmae.—A slender Cocos-like palm of Porto Rico.

Sabal Blackburnianum. Palmae. Royal palmetto. — A large, fan-leaved palm of Jamaica and the West Indies, attaining a height of 100 feet and a circumference of 5–6 feet. The stem is naked and crowned with fan-shaped, glaucous leaves. The black berries, resembling small dates, furnish food for birds. The leaves are used for thatching houses, for making hats, ropes, mats, baskets, etc. The trunk is smooth and hard and is used for utensils.

Sabal Palmetto. Palmae. Cabbage palmetto.—A native palm of Florida, reaching at times 80 feet in height. It has immense leaves and produces a striking appearance growing in groups along the banks of rivers. The trunks are used as piles for wharves, as they are impervious to water. The leaves make fine thatching.

Sabal Adansonii, North America. *S. glaucescens,* Trinidad. *S. havanensis,* Cuba. *S. mauritiaeformis,* West Indies.

Selaginella denticulata. Selaginellaceae. — A native of the Mediterranean region. It is one of the most used of the club mosses, forming a fine green mat over banks in greenhouses. The stems are short and matted.

Selaginella Martensii. Selaginellaceae. Club moss.—A graceful, fern-like plant of Mexico, used extensively for table decoration and in greenhouses. The stems are 6–12 inches long, flat below and angled above.

Strelitzia augusta. Scitamineae.—The plant is native of South Africa, where it attains a height of 20 feet. The leaves are large and banana-like, with small, white flowers produced in a sheath at their base. The stem is hollow, which often causes the plant to topple over.

Strelitzia Reginae. Scitamineae. Bird-of-paradise flower. —A plant somewhat similar to *Strelitzia augusta,* but reaching only 5 feet in height. It is nearly stemless, with oblong leaves 1 foot long, stiff and concave. The leaf-stalks are two or three times as long as the leaves. The conspicuous orange and purple flowers are produced in winter.

Thrinax argentea. Palmae. Silver-thatch palm. — A white-leaved palm of Cuba, also known as the silver-top palmetto. The leaves are used for making brooms, hats, mats, baskets, etc.

Thrinax excelsa. Palmae. — A fan-palm, native of Jamaica.

Thrinax Morrisii, Anguilla. *T. multiflora,* Haiti. *T. parviflora* (thatch palm), Cuba. *T. radiata* (broom palm), Trinidad.

Thunbergia fragrans. Acanthaceae. — A tall, perennial climber, native of India. The stem is slender, the leaves hairy, and the flowers white, fragrant, produced late in the summer. It is used as a greenhouse climber or outdoors upon verandas, arbors, etc., in southern Florida.

Trachycarpus excelsus. Palmae. Hemp palm.—A native of China, first introduced into America and Europe by Robert Fortune, hence also known as Fortune's palm. The fibre around the base of the leaves is used for making brushes, cordage, and hats. Rain-coats have been made by the Chinese from both the leaves and the fibre.

Tradescantia zebrina var. *tricolor*. Commelinaceae. Wandering jew.—A trailing, succulent, perennial herb, native of Mexico. The leaves are red-purple on the under side, silvery white suffused with purple on the upper. The plant is used extensively for covering banks in greenhouses, for hanging-baskets, etc. It roots at the joints and is readily propagated from pieces of stem.

Washingtonia filifera. Palmae. Weeping palm. — A native palm of California, Arizona, and Mexico, and commonly cultivated in California. It grows to a height of 40 feet and has a straight trunk with a shaggy collar of deflexed dead leaves. The effect is striking and picturesque. This is the most hardy of American palms.

Washingtonia Sonorae. Palmae.—A Mexican palm growing 25 feet high. The leaves are 3–4 feet in diameter, glaucous, and filiferous. The fruit is edible. The plant is used for decorative effects.

LECTURE COURSE ON THE DEVELOPMENT OF A SMALL PLACE

By request there has been arranged a course of eight lectures on "The Development of a Small Place" to be given at the Missouri Botanical Garden. These will be held in the graduate lecture room in the office building, entering through the street door on Tower Grove Avenue between Shenandoah and Botanical Avenues, on Wednesdays at ten a. m., beginning November 7. The fee for the course will be five dollars.

1.	**Nov. 7.**	**The Survey**	**Noyes**
2.	**Nov. 14.**	**General Arrangement**	**Noyes**
3.	**Nov. 21.**	**Roads and Walks**	**Noyes**
4.	**Nov. 28.**	**Preparation of the Soil—Lawns**	**Lurie**
5.	**Dec. 5.**	**Planting Materials**	**Lurie**
6.	**Dec. 12.**	**Planting Design**	**Noyes**
7.	**Dec. 19.**	**Planting**	**Lurie**
8.	**Date to be arranged.**	**Maintenance**	**Lurie**

NOTES

Prof. J. M. Coulter, of the University of Chicago, spent the day at the Garden, October 15, and in the evening spoke before the Academy of Science on "The Relation of Botany to Present Economic Problems."

Dr. E. R. Allen, associate in the Ohio Agricultural Experiment Station, in charge of the department of soils and soil chemistry, is now on leave of absence and is pursuing investigations in the graduate laboratory at the Garden.

According to an announcement in Science, Dr. A. R. Davis, Research Assistant to the Garden, 1915–16, has received a commission as Captain in the Coast Artillery, U. S. Reserves, and is at present assistant ordnance officer, Fort Howard, Maryland.

On October 5, Mr. Alexander Lurie, Horticulturist to the Garden, judged the Clifton Heights School exhibit of vegetables and flowers, and on October 27, Mr. G. H. Pring, in charge of conservatories, acted in the same capacity for the Oak Hill School gardens.

The fall and winter floral displays will be inaugurated Sunday, November 4, with the opening of the Chrysanthemum Show. The exhibit will include a considerable number of new forms and an unusually large and attractive collection of all the known types.

On the first "Know St. Louis" automobile tour, September 23, the party, which consisted of about 125 of the city, hotel, and railroad officials and some members of the St. Louis Advertising Club, made a stop at the Garden and were shown about by special guides.

Among the recent visitors to the Garden were Prof. T. Yokoi, President of Tokyo Agricultural College and Professor of Agricultural Economics in the Imperial University of Tokyo, September 26; Dr. L. O. Kunkel, formerly Rufus J. Lackland Research Fellow, now plant pathologist, U. S. Department of Agriculture, October 5; Mr. J. E. Rhodes, Secretary-manager of the Southern Pine Association, October 12; Dr. Norman Taylor, of the Brooklyn Botanic Garden, October 12; Prof. Frank A. Waugh, Professor of Landscape Architecture, Massachusetts Agricultural College, October 22.

Among those appointed as Rufus J. Lackland Fellows for 1917–18, Mr. D. C. Neal resigned on account of a permanent appointment as pathologist on the citrus canker work in southern Alabama; Mr. W. H. Chambers was drafted for military service and has applied for a commission in sanitary work; Mr. Henry Schmitz is now in the Naval Reserves; and Mr. W. S. Reeves is now in the Washington University Base Hospital, Unit 21, in France. Dr. G. W. Freiberg, Research Assistant to the Garden, 1916–17, and Mr. J. W. Severy, Teaching Fellow, 1915–17, are also with the Washington University Base Hospital Unit.

STATISTICAL INFORMATION FOR SEPTEMBER, 1917

Garden Attendance:	
Total number of visitors	26,643
Plant Accessions:	
Total number of plants received in exchange	282
Library Accessions:	
Total number of books and pamphlets bought	14
Total number of books and pamphlets donated	83
Herbarium Accessions:	
By Exchange —	
United States National Museum — Miscellaneous Cryptogams	178
By Gift —	
Dr. W. H. Ballou—*Peniophora sp*	1
Dr. R. P. Burke—Fungi of Montgomery County, Alabama	129
Prof. C. Conzatti—Plants of Mexico	70
J. A. Drushel—Plants of the United States	13
W. W. Ohlweiler—*Clerodendron Bungei* Steudl, a native of China, sent from northern Alabama	1
Geo. H. Pring—Flowering specimen of *Nepenthes Courtii*	1
Mrs. J. B. Reton—*Rhamnus caroliniana* Walt. from St. Louis County, Missouri	1
H. Wangerin—Bulbils of *Furcraea cubensis* Vent., a native of Cuba, cultivated in Switzerland	1
Total	395

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2.00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

Benjamin Minge Duggar,
Physiologist in charge of Graduate Laboratory.

Jesse M. Greenman,
Curator of the Herbarium.

Hermann von Schrenk,
Pathologist.

Edward A. Burt,
Mycologist and Librarian.

Katherine H. Leigh,
Secretary to the Director.

James Gurney,
Head Gardener, *Emeritus.*

William W. Ohlweiler,
General Manager.

John Noyes,
Landscape Designer.

Alexander Lurie,
Horticulturist.

J. J. Coughlin,
Construction.

W. F. Langan,
Engineer.

P. Foerster,
Farm and Stables.

G. H. Pring,
Conservatories.

H. Vallentine,
Carpenter.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. V NOVEMBER, 1917 No. 11

MISSOURI BOTANICAL GARDEN
1889

CONTENTS

Page
The Poinsettia - - - - - - - - - 157
Damage to Greenhouse Plants at Garden Due to Smoke - - - - - - - - 160
Floral Display for December - - - - - 161
Plants in the Fern House - - - - - - 162
Notes - - - - - - - - - - 164
Statistical Information - - - - - - 165

ST. LOUIS, MO.
1917
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

BOARD OF TRUSTEES OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

Edward C. Eliot.
George C. Hitchcock.
P. Chouteau Maffitt.
Edward Mallinckrodt.
Leonard Matthews.
William H. H. Pettus.
Philip C. Scanlan.
John F. Shepley.

EX-OFFICIO MEMBERS

Edmund A. Engler,
President of The Academy of Science of St. Louis.

Frederic A. Hall,
Chancellor of Washington University.

Henry W. Kiel,
Mayor of the City of St. Louis.

Richard Murphy,
President of the Board of Education of St. Louis.

Daniel S. Tuttle,
Bishop of the Diocese of Missouri.

Roland W. Switzer, Secretary.

Missouri Botanical
Garden Bulletin

Vol. V St. Louis, Mo., November, 1917 No. 11

THE POINSETTIA

The poinsettia (*Euphorbia pulcherrima*), otherwise known as the Christmas flower or Mexican flame-leaf, is one of the few plants belonging to the Euphorbiaceae that is cultivated commercially for ornamental purposes. The flowers are insignificant, but the brilliant bracts upon which they rest possess such an intensity of color and are so large that the effect produced is scarcely equaled by any other plant under cultivation. Since its introduction from Mexico, in 1834, the poinsettia has become much used for decoration at Christmas, its popularity being enhanced by the fact that even after the lower green leaves drop off the bracts remain for a long period.

The plant is a shrub 2–10 feet in height, found in most shaded parts of tropical Mexico and Central America. The lower leaves are green, ovate-elliptical, toothed or lobed, and prominently veined. The upper leaves or bracts are narrower and vermilion-red in color. The flowers are greenish with large yellow glands. In 1873 M. Benedict Roezl discovered in a small Indian village in the state of Guerrero, Mexico, a double form, *Euphorbia pulcherrima* var. *plenissima.* This new form is remarkable for its size—the head of the bracts reaching 18 inches across and 11 inches in depth—, its distinct character, and its marvelous brilliancy. The central cyme of flowers is surmounted by bracts from which other flowers develop on short, simple stems, each surmounted by bracts and flowers. The secondary heads become further subdivided, culminating in a mass of red. Often many of the flowers are converted into bracts, as many as 50 having been observed on a single stem.

The possibility of newer development in the poinsettia has been shown by the crossing of *Euphorbia pulcherrima* and *E. lutescens,* with the resultant *E. salmonea* var. *Adneti. Euphorbia lutescens* is similar to *E. pulcherrima* but differs in the color of its bracts, which are greenish white, and the more vigorous and abundant foliage. The hybrid, known as the pink poinsettia, has oval-elliptical leaves 10–12 cm. long, more deeply cut than those of the red poinsettia. The flowers are larger and more spreading, the bracts are numerous, well-formed, and of a pleasing salmon-pink tinge. It possesses other advantages over its red parent, in that it is 2 or 3 weeks earlier and has greater lasting qualities, the bracts having been known to last 75 days without dropping off or losing color. Other crosses have been made, among which the most interesting is one showing a tendency toward yellow. This may be a turning point toward the development of a yellow type, which would greatly increase the scope of usefulness of the poinsettia. Two other varieties are observed occasionally, the *E. pulcherrima* var. *alba* (yellowish white) and *E. pulcherrima* var. *albida* (white with a pinkish tinge).

For decorative purposes the poinsettias may be used as cut flowers with 2 or 3 feet of stem, or as pot plants. The latter method is more satisfactory because the bracts and foliage will often wilt badly when cut. This may be remedied to a certain extent by cauterizing the stems when first cut, i. e., plunging them in boiling water and then in cold water. Dipping the stems in melted wax or burning with a hot iron is not desirable because the absorption of water is interfered with.

The comparatively simple culture of the poinsettia adds to its popularity. The plants require a long period of rest, being dried off for a period of 10–12 weeks. The old plants after flowering in January are placed on their sides in a temperature of 45–50° F. and kept in a dormant condition until April or May. At this time they are shaken out of their old pots and repotted into new rich soil. The plants are then cut back to sound wood and placed upon a sunny bench at a temperature of 60° F. Aided by frequent syringing the buds soon start at the top, and in 4 or 5 weeks the first crop of cuttings may be taken. When this has been accomplished the stock plants should be plunged outdoors, as the cuttings made from outdoor growth make better plants. The last cuttings should not be taken later than August, these forming satisfactory plants in small pans for table decoration at Christmas.

The most common way of taking cuttings is to cut off a shoot 4–5 inches in length, with a heel of the older wood, care being taken to leave at least one bud at the base which will break and produce other cuttings. Some growers think that the cuttings root more readily and the milky juice is not wasted to such a large extent if at first the shoots are cut only half-way through and a day or two later severed from the parent plant. As the cuttings go into sand after the bottom heat is reduced, they must be well shaded and kept moist, especially upon hot days. By this method they will root in about 3 weeks. Sometimes the cuttings are potted singly in 2½-inch pots of sand with a little sphagnum moss at the bottom for the roots to grip. These pots should be placed in a tight case, shaded, and kept at a temperature of 65° F. As soon as rooted the cuttings are potted into 3½-inch pots, using a mixture of equal parts of loam, leaf mold, and sand. For the first few days until the plants become established they should be shaded and kept moist by frequent syringing. After that, full sunlight and plenty of fresh air are required. In general, the temperature should never go below 50° F. at night, and as soon as plants begin to show color it should be raised to 65–70° F. When the bracts and flowers have developed properly the temperature should be decreased gradually to harden the plants off and thus increase their lasting qualities. For the final potting the plants are shifted from 3½-inch to 6-inch pots, using a mixture of 3 parts good loam and 1 part cow manure or ⅙ sheep manure. The young plants should be fed with liquid manure once a week until the flowers appear. In the event of their becoming too tall during the summer months the stems are ringed within 6–7 inches of the top about the end of August. They should be cut half-way through at first and left for a couple of weeks until a callus is formed. The shoots may then be severed, potted into 3-inch pots in a mixture of sand and loam, and kept in a close case until well rooted. The subsequent treatment is the same as that previously described for cuttings.

Often much of the beauty of the poinsettia is lost by allowing the handsome green foliage to become yellow and drooping. This state may be caused by too low a temperature, drought, starvation at the roots—either because of poor soil or lack of root room—, or disturbance of the roots by late potting. This last is one of the commonest troubles, as the plants cannot endure to have their roots disturbed when near the flowering period.

Due to the acrid milky juice contained in the plants, insect pests are comparatively few. The mealy bug and the green fly may be eradicated by syringing and tobacco fumigation. The white fly may be exterminated by the use of hydrocyanic gas.

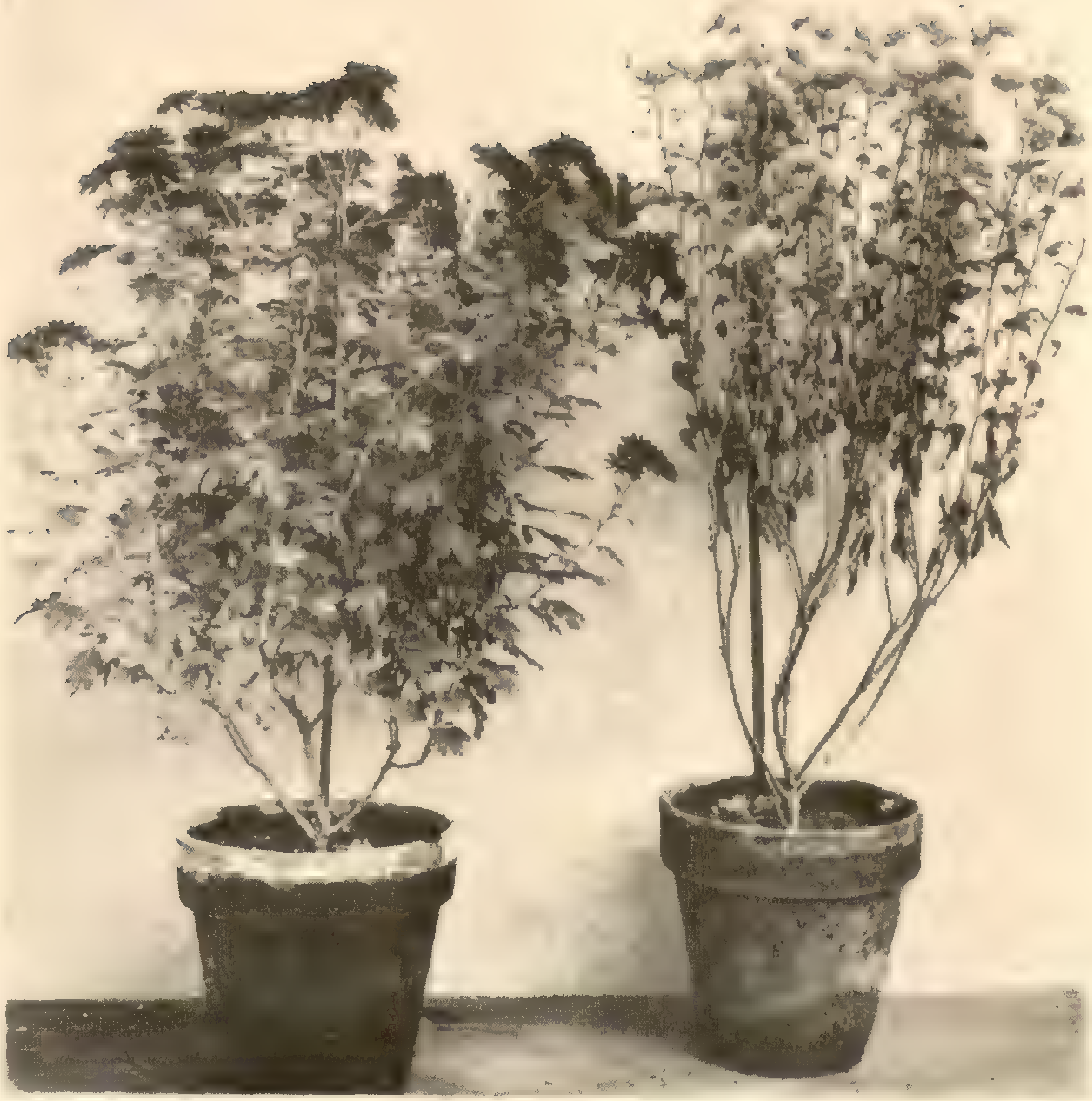
DAMAGE TO GREENHOUSE PLANTS AT GARDEN DUE TO SMOKE

During the month of November several heavy fogs occurred in St. Louis, the one on the 9th—because of the excessive amount of smoke — causing considerable injury to the greenhouse plants at the Garden. Fog is usually accompanied by high humidity, still atmosphere, and a fall of temperature. Under these conditions every floating particle becomes coated by a film of water, and, due to this extra weight, remains stationary or falls, considerably impeding the movement of air. This stagnation of atmosphere permits the accumulation of the products of combustion in the immediate vicinity of plants, which under normal conditions would be more or less dispersed by the circulation of air.

It is a matter of common knowledge that soot and certain gases are injurious to plant life. Soot exerts a detrimental influence by blocking up the air pores of the leaf, thus impeding the process of transpiration, as well as by coating the leaf, which reduces the action of sunlight and affects the food manufacturing function of the plant. Most plants are sensitive to these abnormal conditions, but out of doors the evergreens, with their persistent leaves and their deeply sunk air pores, which form efficient traps for the particles of soot, are unusually susceptible. This is one reason why conifers do so poorly in the smoky atmosphere of the city.

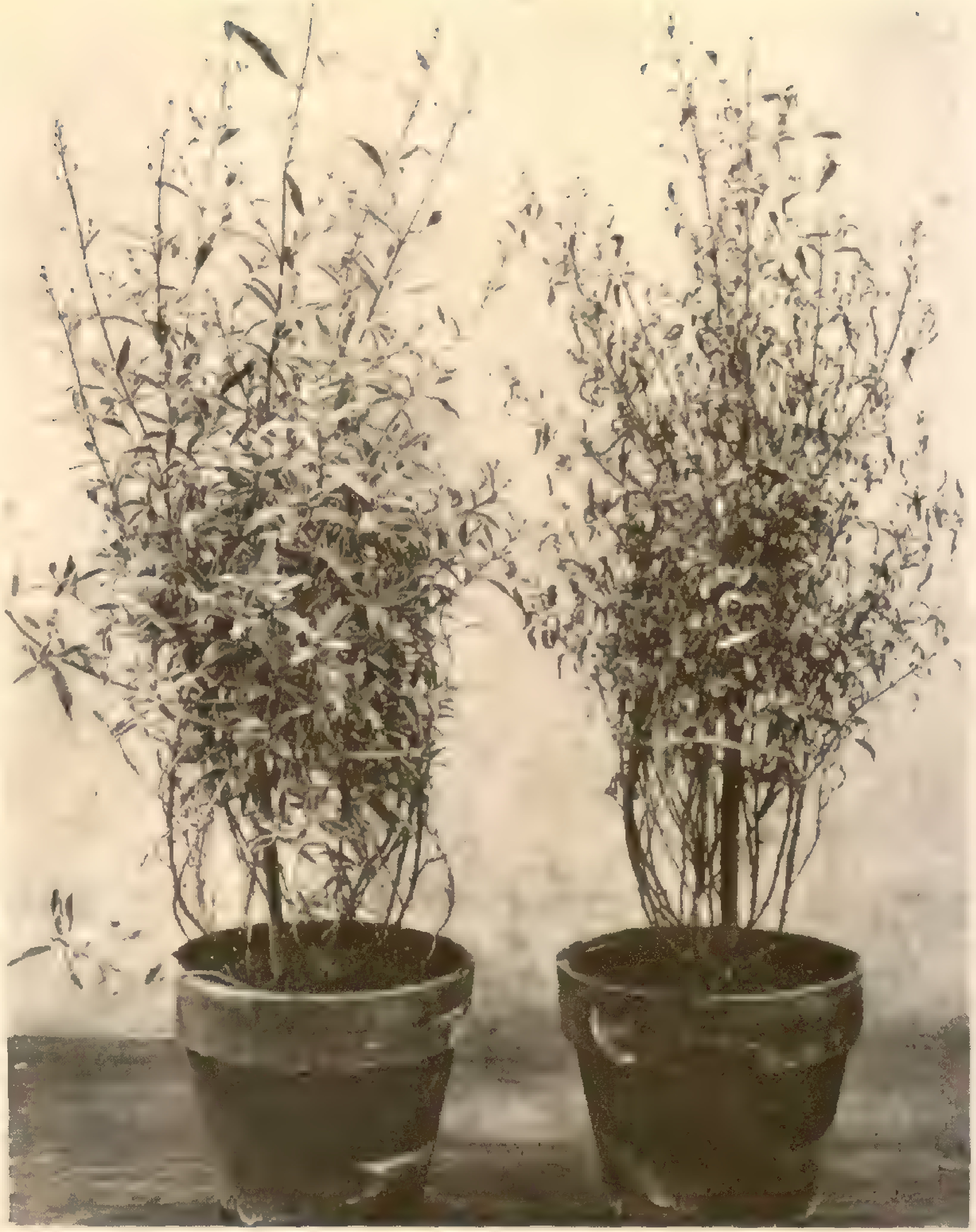
The most injurious and wide-spread product of coal combustion is sulphurous acid, produced by the burning of sulphur usually present in considerable quantities in soft coal. Not only is this gas directly injurious, but because of the readiness with which it combines with water, forming sulphuric acid, a corrosive action soon sets in, resulting in the drying, blackening or curling of more delicate portions of the plants, such as the tips and margins of leaves, young shoots, and expanding flowers. The extent of the injury is dependent to a degree upon the activity of the plant, and during the day when the rate of absorption is greater, the action of poisonous gases is apt to be more detrimental. Should the fog with its deleterious contents be of prolonged duration, complete defoliation may take place. Furthermore, even though external evidences of damage may be slight, the internal injury may be great, since large areas of growing tissue are generally affected, causing a weakened condition, with a subsequent susceptibility to fungous attacks and other troubles.

The accompanying photographs of plants, made within a day or two after the fog, only partially show the extent of



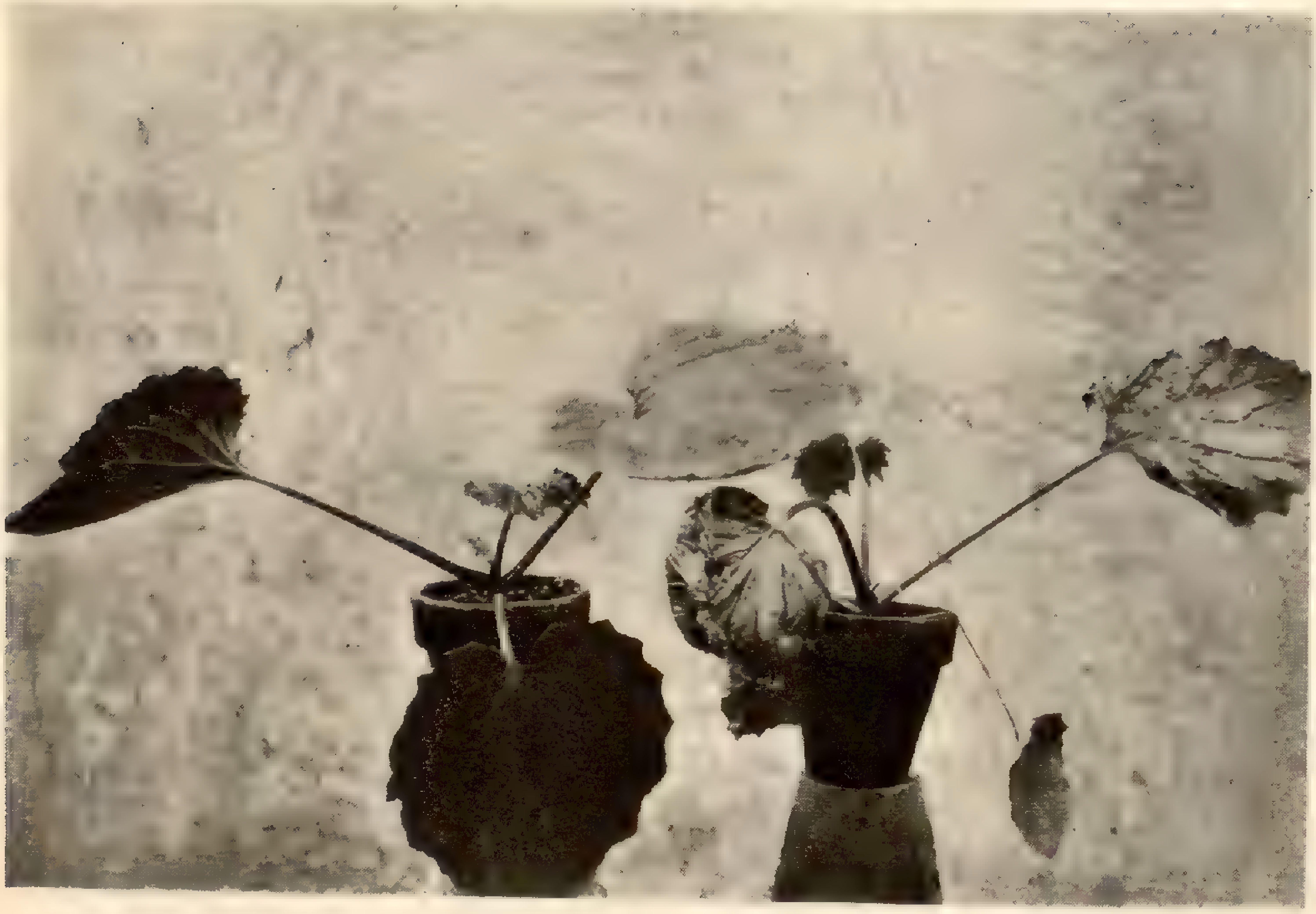
HEALTHY. AFFECTED.

CHRYSANTHEMUM.



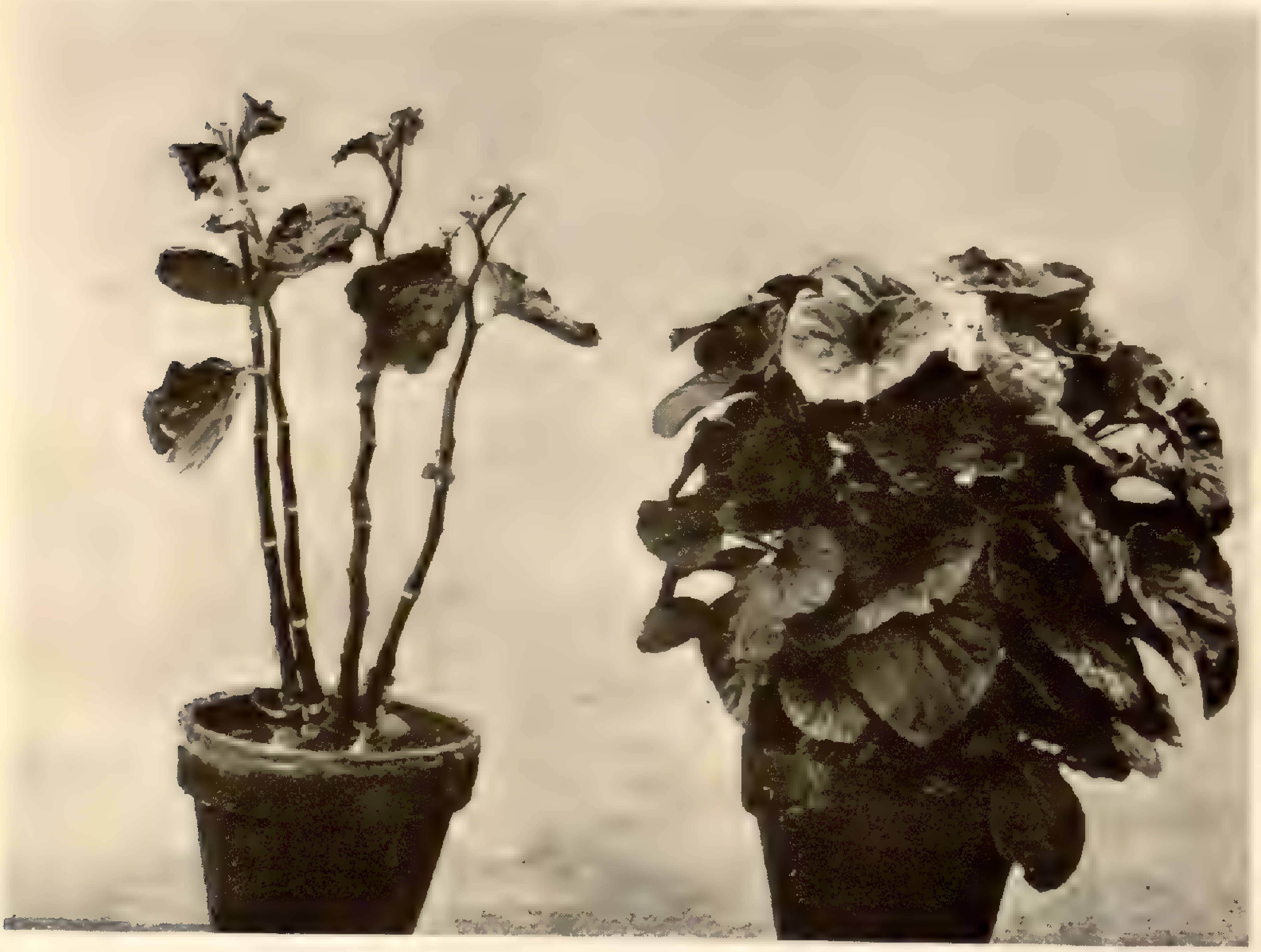
HEALTHY. AFFECTED.

STEVIA.



HEALTHY. AFFECTED.

CINERARIA.



AFFECTED. HEALTHY.

BEGONIA SEMPERFLORENS.

the damage, since it is practically impossible to reproduce all of the effect which is so apparent to the naked eye. What the ultimate effect may be upon these plants remains to be seen. Below are listed some of the plants most seriously affected:

Alternanthera versicolor	Leaves dropped
Azalea indica	Leaves dropped
Begonia semperflorens	Leaves browned at edge
Calanthe	Young shoots blighted
Catasetum	Young shoots blighted
Cattleya	Flowers dropped
Chrysanthemum	Foliage browned, dropped
Cineraria	Leaves browned at edge
Cuphea hyssopifolia	Leaves dropped
Dendrobium	Flowers failed to open
Duranta integrifolia	Leaves dropped
Ferns	Leaves browned
Hydrangea Hortensia	Leaves blackened
Laelia	Flowers dropped
Poinsettia (*P. pulcherrima*)	Leaves yellowed
Primula sinensis	Leaves browned at edge
Solanum Pseudo-capsicum	Leaves dropped
Piqueria (Stevia)	Leaves blighted

FLORAL DISPLAY FOR DECEMBER

The floral display for December will be dominated by the Christmas color of red, two thousand poinsettias and many hundred solanums (Christmas cherries) constituting the greater part of the exhibit. Besides the common red poinsettia, the French pink and white hybrids which were shown for the first time in St. Louis at the Garden last winter, will appear this year in even greater abundance. As a setting for the poinsettias, many potted plants of stevia, with their dense variegated foliage and loosely panicled white flowers, and the early-flowering paper-white narcissus will be used. About 250 specimens of calendula, an annual commonly called the pot marigold, will also be displayed, their yellow flowers lending variety to the red and white color scheme.

The orchid alcoves in the adjoining house will contain the collection of early-flowering slipper orchids, the rare yellow specimen, *Cypripedium insigne* var. *Sanderae,* being represented by thirty plants. The common type known as the cattley orchid, together with many other less-known varieties, will be shown the latter part of the month. Other interesting plants to be seen in December are the quinine plant, flowering in the varied industries house, and the melon pawpaw and the tree tomato in fruit on the east side of the economic house.

PLANTS IN THE FERN HOUSE

Acrostichum aureum. Polypodiaceae. South America.
Acrostichum sp. Polypodiaceae. South America.
Acrostichum tenuifolium. Polypodiaceae. South America.
Adiantum Capillus-Veneris. Polypodiaceae. Southern Europe.
Adiantum caudatum. Polypodiaceae. Old World.
Adiantum Collisii. Polypodiaceae. Garden hybrid.
Adiantum cuneatum var. *Croweanum.* Polypodiaceae. Brazil.
Adiantum cuneatum var. *grandiceps.* Polypodiaceae. Brazil.
Adiantum cuneatum var. *Rochfordianum.* Polypodiaceae. Tropics.
Adiantum cuneatum var. *Roenbeckii.* Polypodiaceae. Brazil.
Adiantum diaphanum. Polypodiaceae. Southern Asia.
Adiantum Fergusonii. Polypodiaceae. Southern Europe.
Adiantum Hemsleyanum. Polypodiaceae. Tropics.
Adiantum hispidulum. Polypodiaceae. Old World.
Adiantum patens. Polypodiaceae. Tropics.
Adiantum rubellum. Polypodiaceae. Bolivia.
Adiantum tenerum. Polypodiaceae. Tropical America.
Adiantum tetraphyllum. Polypodiaceae. Tropics.
Adiantum trapeziforme. Polypodiaceae. Tropical America.
Adiantum villosum. Polypodiaceae. West Indies.
Allantodia superba. Polypodiaceae. Tropics.
Alsophila armata. Cyatheaceae. Australia.
Alsophila australis. Cyatheaceae. Australia.
Alsophila gigantea. Cyatheaceae. Australia.
Alsophila sp. (Van Schrenk). Cyatheaceae.
Angiopteris evecta. Marattiaceae. India.
Aristolochia elegans (calico flower). Aristolochiaceae. Brazil.
Aristolochia macoura. Aristolochiaceae. Tropics.
Aristolochia ovalifolia. Aristolochiaceae. Tropics.
Aristolochia pardina. Aristolochiaceae. Tropics.
Aristolochia regale. Aristolochiaceae. Tropics.
Aristolochia sp. Aristolochiaceae. Tropics.
Asplenium Belangeri. Polypodiaceae. East Indies.
Asplenium bulbiferum. Polypodiaceae. South Africa.
Asplenium Filix-foemina. Polypodiaceae. North America.
Asplenium Nidus. Polypodiaceae. Brazil.
Asplenium sp. Polypodiaceae. South America.
Bignonia buccinatoria. Bignoniaceae. South America.
Bignonia Sadleri. Bignoniaceae. South America.
Blechnum brasiliense. Polypodiaceae. Brazil.
Blechnum hastatum var. *minus.* Polypodiaceae. South America.
Blechnum occidentale. Polypodiaceae. South America.
Bougainvillea glabra. var. *variegata.* Nyctaginaceae. Brazil.
Ceropteris chrysophylla. Polypodiaceae. Brazil.
Ceropteris sulphurea. Polypodiaceae. West Indies.
Ceropteris tartarea. Polypodiaceae. Tropical America.
Cibotium glaucum. Cyatheaceae. Hawaiian Islands.
Cibotium Schiedei. Cyatheaceae. Mexico.
Cyathea dealbata. Cyatheaceae. New Zealand.
Davallia affinis. Polypodiaceae. Southern Asia.
Davallia bullata. Polypodiaceae. India.
Davallia fijiensis var. *plumosa.* Polypodiaceae. Fiji Islands.
Davallia Griffithiana. Polypodiaceae. Southern Asia.
Davallia Speluncae. Polypodiaceae. Southern Asia.
Dicksonia antarctica. Cyatheaceae. Australia.
Drymoglossum spatulatum. Polypodiaceae. Tropics.

Hemionitis palmata (strawberry fern). Polypodiaceae. Mexico and West Indies.
Ipomoea grandidentatum. Convolvulaceae. Tropics.
Ipomoea tuberculata. Convolvulaceae. Tropics.
Lomaria gibba. Polypodiaceae. South America.
Lygodium volubile. Schizaeaceae. Southern Asia.
Nephrodium macrophyllum. Polypodiaceae. North America.
Nephrodium molle. Polypodiaceae. North America.
Nephrodium molle var. *grandiceps.* Polypodiaceae. North America.
Nephrodium patulum. Polypodiaceae. North America.
Nephrodium setigerum. Polypodiaceae. North America.
Nephrolepis cordifolia. Polypodiaceae. Mexico and Japan.
Nephrolepis cordifolia var. *Duffii.* Polypodiaceae. New Zealand.
Nephrolepis cordifolia var. *pectinata.* Polypodiaceae. Mexico, Japan, and New Zealand.
Nephrolepis davallioides. Polypodiaceae. Java.
Nephrolepis davallioides var. *furcans.* Polypodiaceae. Java.
Nephrolepis exaltata. Polypodiaceae. South America and southern Asia.
Nephrolepis exaltata var. *Piersonii* f. *compacta.* Polypodiaceae. South America and East Africa.
Nephrolepis exaltata var. *Washingtoniensis.* Polypodiaceae. Gardens.
Nephrolepis Zollingeriana. Polypodiaceae. Tropical America.
Osmunda sp. Osmundaceae. North America.
Passiflora edulis. Passifloraceae. Brazil.
Passiflora maliformis. Passifloraceae. South America.
Passiflora reflexiflora. Passifloraceae. South America.
Pellaea hastata. Polypodiaceae. Tropical America.
Platycerium aethiopicum. Polypodiaceae. Guinea.
Platycerium alcicorne. Polypodiaceae. Temperate Australia.
Platycerium alcicorne var. *Hillii.* Polypodiaceae. Queensland.
Platycerium grande. Polypodiaceae. Northern Australia.
Platycerium Veitchii. Polypodiaceae. Temperate Australia.
Polypodium angustifolium. Polypodiaceae. Tropical America.
Polypodium angustifolium var. *lancifolium.* Polypodiaceae. Tropical America.
Polypodium aroides. Polypodiaceae. Tropical America.
Polypodium aureum. Polypodiaceae. Florida and tropical America.
Polypodium aureum var. *sporadocarpum.* Polypodiaceae. Tropical America.
Polypodium crassifolium. Polypodiaceae. Tropical America.
Polypodium Meyenianum. Polypodiaceae. Philippine Islands.
Polypodium Phyllitidis. Polypodiaceae. Tropical America.
Polypodium phymatodes. Polypodiaceae. Tropical America.
Polypodium polypodioides. Polypodiaceae. Virginia and southern Illinois to Brazil.
Polypodium pustulatum. Polypodiaceae. Tropical America.
Polypodium quercifolium. Polypodiaceae. Tropical America.
Polypodium sp. Polypodiaceae. Tropical America.
Polypodium subauriculatum. Polypodiaceae. India to Australia.
Polypodium vacciniifolium. Polypodiaceae. West Indies.
Polystichum aculeatum var. *lobatum.* Polypodiaceae. Europe and California.
Polystichum angulare. Polypodiaceae. California.
Polystichum falcatum. Polypodiaceae. Japan.
Polystichum falcatum var. *Fortunei.* Polypodiaceae. Japan.
Polystichum sp. Polypodiaceae. United States.
Polystichum Tsus-sinense. Polypodiaceae. California.

Psilotum triquetrum. Lycopodiaceae. Tropics.
Pteris cretica var. *albo-lineata.* Polypodiaceae. Tropical regions.
Pteris cretica var. *Wilsonii.* Polypodiaceae. Tropical regions.
Pteris longifolia. Polypodiaceae. Tropical regions.
Pteris serrulata. Polypodiaceae. China and Japan.
Rhynchosia phaseoloides. Leguminosae. Panama, Brazil, and West Indies.
Selaginella cuspidata var. *Emmeliana.* Selaginellaceae. Cuba and Mexico.
Selaginella Martensii var. *variegata.* Selaginellaceae. Mexico.
Solandra guttata. Solanaceae. North America.
Stigmaphyllon ciliatum. Malpighiaceae. Tropical America.
Vitis nitens. Vitaceae. North America.
Woodwardia radicans. Polypodiaceae. California and Mexico.

NOTES

Dr. Hermann von Schrenk, Pathologist to the Garden, has been elected president of the St. Louis Garden Club.

Mr. Lewis H. Weld, of Northwestern University, recently consulted the herbarium in connection with his studies on insect galls of oaks.

Miss Anne W. Davis, Bryn Mawr, 1917, has been appointed research assistant to succeed Dr. G. W. Freiberg, who is now in France.

On November 13, Dr. Hermann von Schrenk, Pathologist to the Garden, addressed the Kirkwood Monday Evening Club on "My Summer in the Garden."

Mr. Alexander Lurie, Horticulturist to the Garden, gave a talk on "The Storage of Vegetables" before the Household Science Club of Belleville, at the Carnegie Library, October 26.

Mr. George H. Pring, in charge of conservatories, gave an illustrated lecture before the St. Louis Gardeners' Association, November 22, on "The Botanic Gardens, Kew, England."

Mr. Alexander Lurie, Horticulturist to the Garden, has been appointed chairman of the special premiums committee of the National Flower Show to be held in St. Louis, April 5–16, 1918.

Mr. J. J. Schilthuis, of the Vereenigde Indische Exploitatie Maatschappijen, of Amsterdam, visited the Garden November 9. Mr. Schilthuis is to have charge of a laboratory for the investigation of tropical woods in Java and is now on his way to the East Indies.

STATISTICAL INFORMATION FOR OCTOBER, 1917

GARDEN ATTENDANCE:

Total number of visitors	26,405

PLANT ACCESSIONS:

Total number of plants and seeds donated	18
Total number of plants received in exchange	5

PLANT DISTRIBUTION:

Total number of plants distributed in exchange	3

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	15
Total number of books and pamphlets donated	101

HERBARIUM ACCESSIONS:

By Exchange —	
California Academy of Sciences, by Miss Alice Eastwood—Plants of the Galapagos Islands	397
C. W. Dodge—Plants of Vermont	5
E. L. Johnston—Plants of Colorado	78
E. D. Merrill—*Ionidium sp.* from the Philippine Islands	1
By Purchase —	
Canton Christian College—Plants of China	330
Dr. S. M. Zeller—Plants of Washington	472
By Gift —	
Dr. W. H. Ballou—Fungi from White Plains, N. Y.	2
Dr. R. P. Burke—Fungi of Alabama	67
J. A. Drushel—Plants of Missouri, Texas, and Colorado	10
H. East—*Helianthus Maximiliani* Schrad. from Texas	1
Dr. W. G. Farlow—Fungi of New Hampshire and Massachusetts	3
Mrs. K. H. Leigh—*Rhamnus caroliniana* Walt. from Missouri	1
New York Botanical Garden, by Dr. W. A. Murrill—Miscellaneous collections of Thelephoraceae (Number to be determined)	
Dr. L. O. Overholts—Fungi of Pennsylvania	8
Mrs. E. R. Paillou—*Solidago petiolaris* Ait. from Missouri	1
A. S. Rhoads—Thelephoraceous fungus, parasitic on *Ginkgo*	1
Dr. S. M. Zeller—*Rhizopogon sp.* from Washington	1
TOTAL	1,378

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2.00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

BENJAMIN MINGE DUGGAR,
Physiologist in charge of Graduate Laboratory.

HERMANN VON SCHRENK,
Pathologist.

JESSE M. GREENMAN,
Curator of the Herbarium.

EDWARD A. BURT,
Mycologist and Librarian.

ANNE W. DAVIS,
Research Assistant.

KATHERINE H. LEIGH,
Secretary to the Director.

JAMES GURNEY,
Head Gardener, *Emeritus.*

JOHN NOYES,
Landscape Designer.

ALEXANDER LURIE,
Horticulturist.

J. J. COUGHLIN,
Construction.

P. FOERSTER,
Farm and Stables.

W. F. LANGAN,
Engineer.

G. H. PRING,
Conservatories.

H. VALLENTINE,
Carpenter.

MISSOURI BOTANICAL GARDEN BULLETIN

Vol. V DECEMBER, 1917 No. 12

1889

CONTENTS

	Page
Transplanting Trees	167
Birds in the Missouri Botanical Garden	172
Notes	173
Statistical Information for November	174
Index to Illustrations of Volume V	177
General Index to Volume V	179

ST. LOUIS, MO.
1917
PUBLISHED MONTHLY BY THE BOARD OF TRUSTEES

SUBSCRIPTION PRICE:
ONE DOLLAR PER YEAR SINGLE NUMBERS TEN CENTS

BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN

THE ORIGINAL MEMBERS WERE DESIGNATED IN MR. SHAW'S WILL, AND THE BOARD SO CONSTITUTED, EXCLUSIVE OF THE *EX-OFFICIO* MEMBERS, IS SELF-PERPETUATING.

President,
EDWARDS WHITAKER.

Vice-President,
DAVID S. H. SMITH.

EDWARD C. ELIOT.
GEORGE C. HITCHCOCK.
P. CHOUTEAU MAFFITT.
EDWARD MALLINCKRODT.
LEONARD MATTHEWS.
WILLIAM H. H. PETTUS.
PHILIP C. SCANLAN.
JOHN F. SHEPLEY.

EX-OFFICIO MEMBERS

EDMUND A. ENGLER,
President of The Academy of Science of St. Louis.

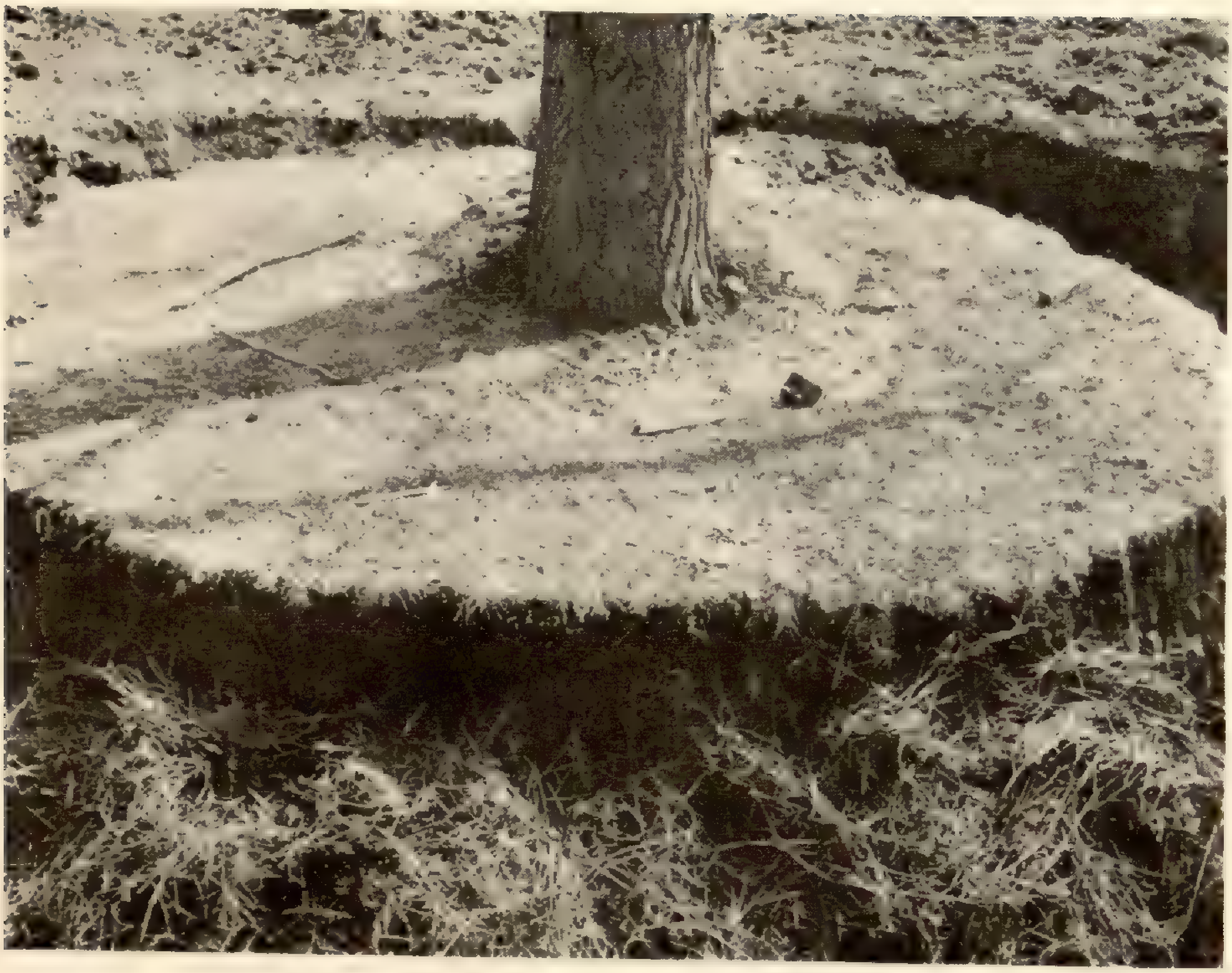
FREDERIC A. HALL,
Chancellor of Washington University.

HENRY W. KIEL,
Mayor of the City of St. Louis.

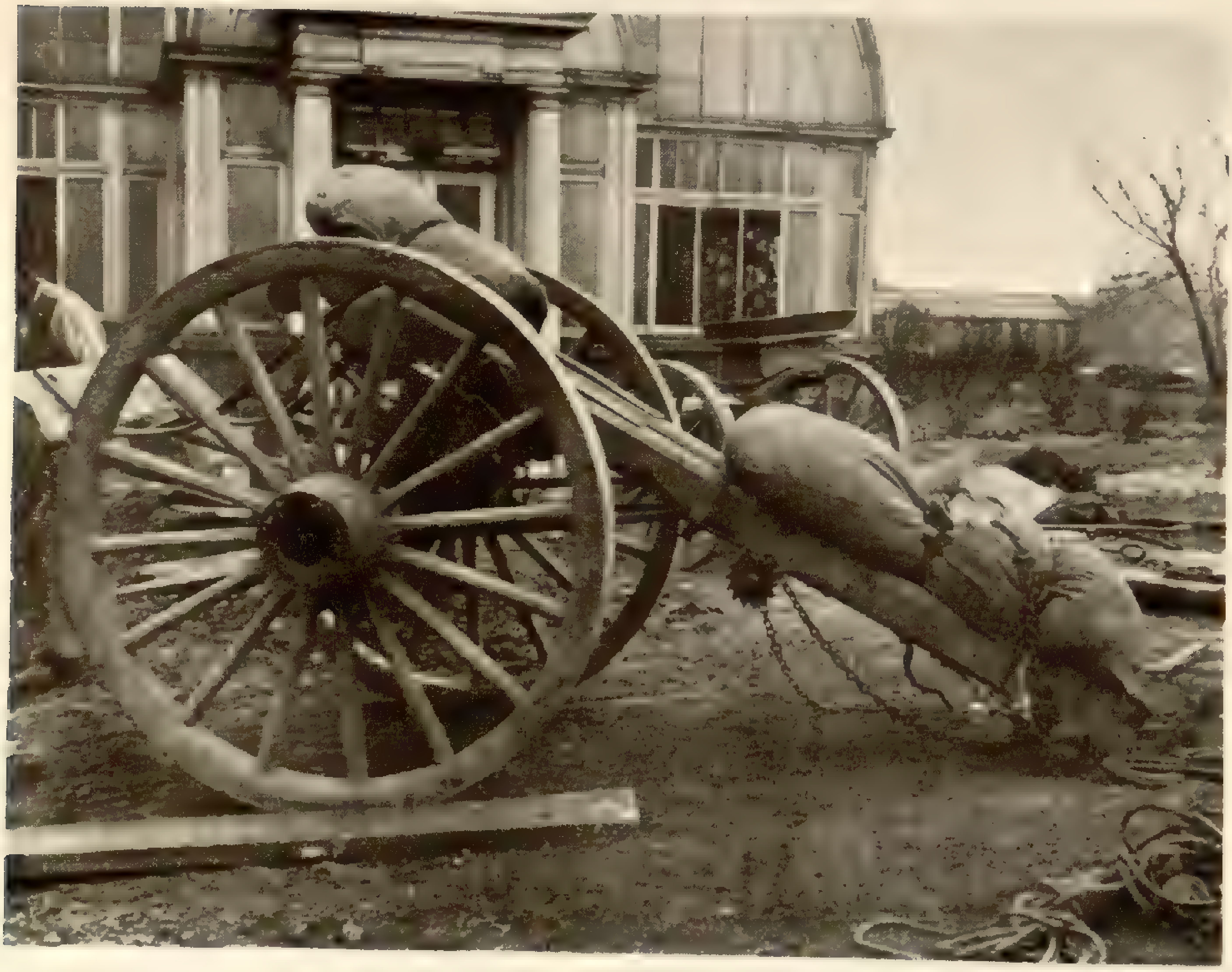
RICHARD MURPHY,
President of the Board of Education of St. Louis.

DANIEL S. TUTTLE,
Bishop of the Diocese of Missouri.

ROLAND W. SWITZER, Secretary.



THE BALL OF AN 18-INCH TREE DUG.



THE REAR AXLE, WITH BOOM AND BACK STEP.

Missouri Botanical Garden Bulletin

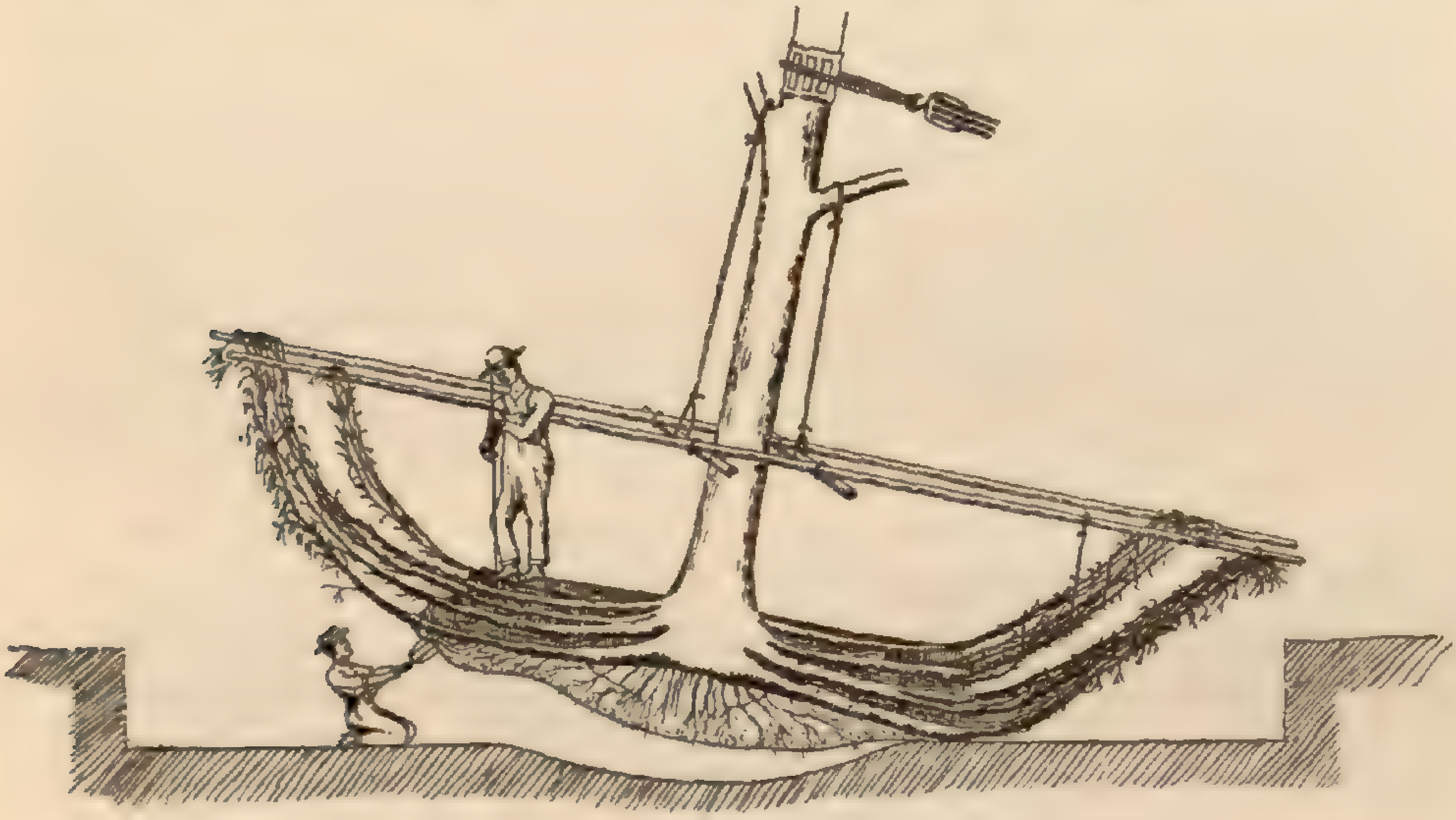
Vol. V St. Louis, Mo., December, 1917 No. 12

TRANSPLANTING TREES

The increased knowledge of, and experience in, moving large trees has resulted in a large degree of success and safety, enabling the immediate production of effects in landscape plantings which otherwise could only be attained at the end of a long period of years. The appreciation of the effects thus rapidly produced has proven a strong stimulus in the development of this branch of horticulture, and at the present time many landscape gardeners and nurserymen are successfully moving trees 18–24 inches in diameter and 30–50 feet high. In order to achieve the desired results emphasis must be laid upon possession of proper equipment, thorough knowledge of tree structure, its requirements, and time of moving of specific individuals, as well as provision for thorough drainage for the newly transplanted trees.

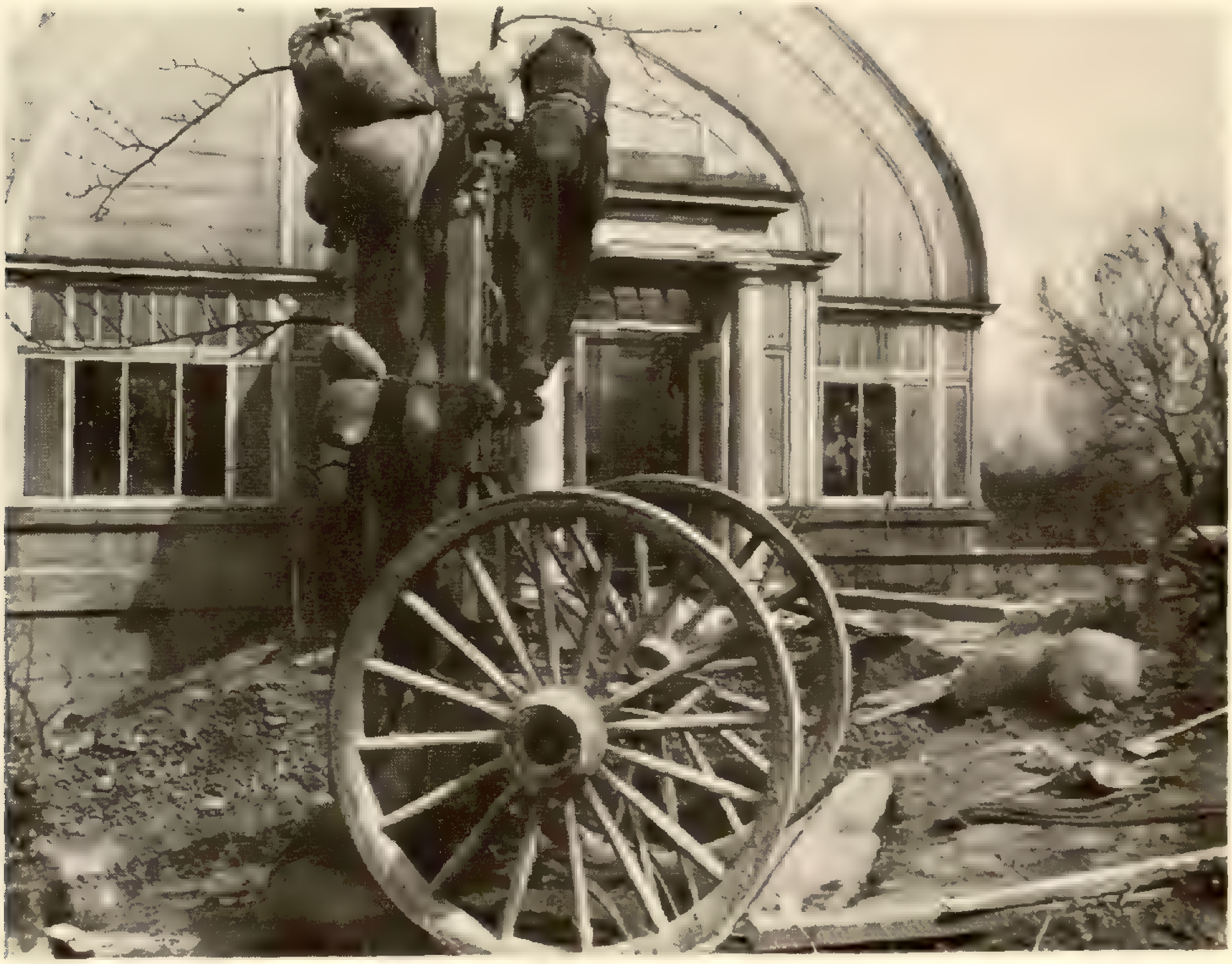
Large trees are moved either by digging them with a large ball of earth in which many fibrous roots are contained or by loosening the majority of the roots to their full length and lifting the tree without any soil. The deciduous trees may be moved in either manner, but the evergreens can be transplanted successfully only by digging with a large ball, due to the fact that they are never actually dormant. The former are best moved during their dormant season, in the fall, winter, or spring, depending upon the different kinds. For an example, it is not advisable to move sweet-gum (*Liquidambar Styraciflua*), tulip tree (*Liriodendron tulipifera*), various magnolias, holly (*Ilex opaca*), bald cypress (*Taxodium distichum*), etc., in the fall or winter, because in order to thrive these trees must start new growth immediately upon transplanting. On the other hand, elms (Ulmus), maples (Acer), oaks (Quercus), ashes (Fraxinus), etc., may be moved at any time during the dormant period. The evergreens may be moved either early in the spring or early in the fall, though successful transplanting has been accomplished at other times of the year. In fact, with great and painstaking care both the deciduous trees and the evergreens may be moved while in the full growing condition during the summer.

There are several ways of moving trees with a ball. A number of different tree-moving machines are employed, or for lack of these a stone wagon may be used for medium-sized trees. The ball of the tree is dug in accordance with the specific requirements of the machine in use. The operations involved for one type of machine are as follows: A heavy truck with a boom or pole attached (often called "the gun") is lashed to the tree by means of chains, which are tightened with a ratchet attachment, the tree having been previously padded with straw bags at points of fastening. At the bottom of the truck is located a step-like structure which fits into a trench dug 2 feet away from the trunk of the tree and acts as a brace in bringing the tree out of the hole into a horizontal position. This arrangement necessitates the digging of an uneven ball which is only 2 feet wide on one side while it may be 8–10 feet on the other. Care should be taken to leave all fibrous roots, cutting only the largest which are likely to extend a considerable distance out. It is sometimes well to prepare the trees beforehand, in June, by trimming and cutting the roots at a proper distance from the trunk. These roots heal over and fill the ball with numerous fibres. The growth is further stimulated by application of manure or commercial fertilizers. Artificial watering must be resorted to, however, if the tree is to remain healthy and vigorous.

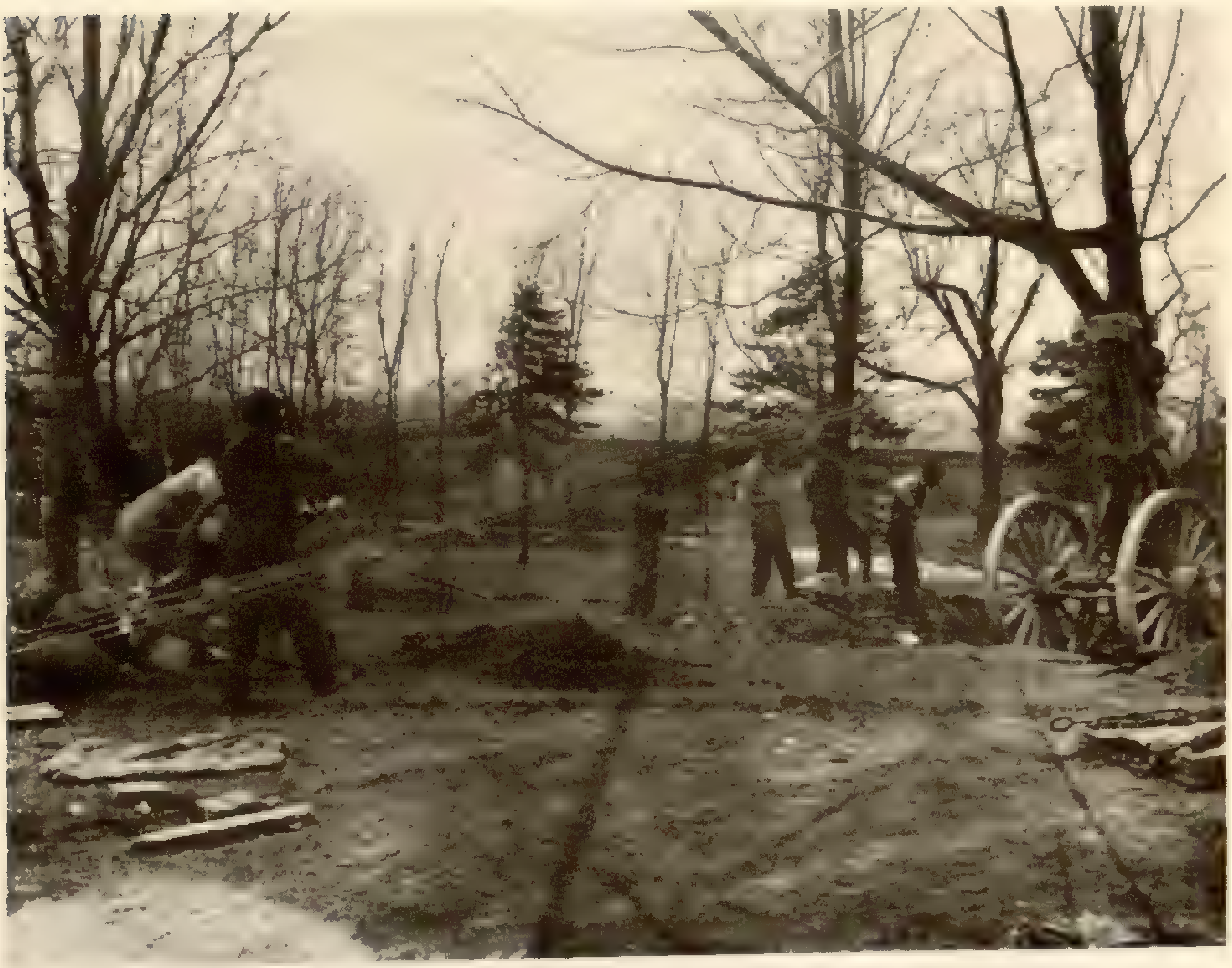


A LARGE TREE BEING PREPARED FOR MOVING.

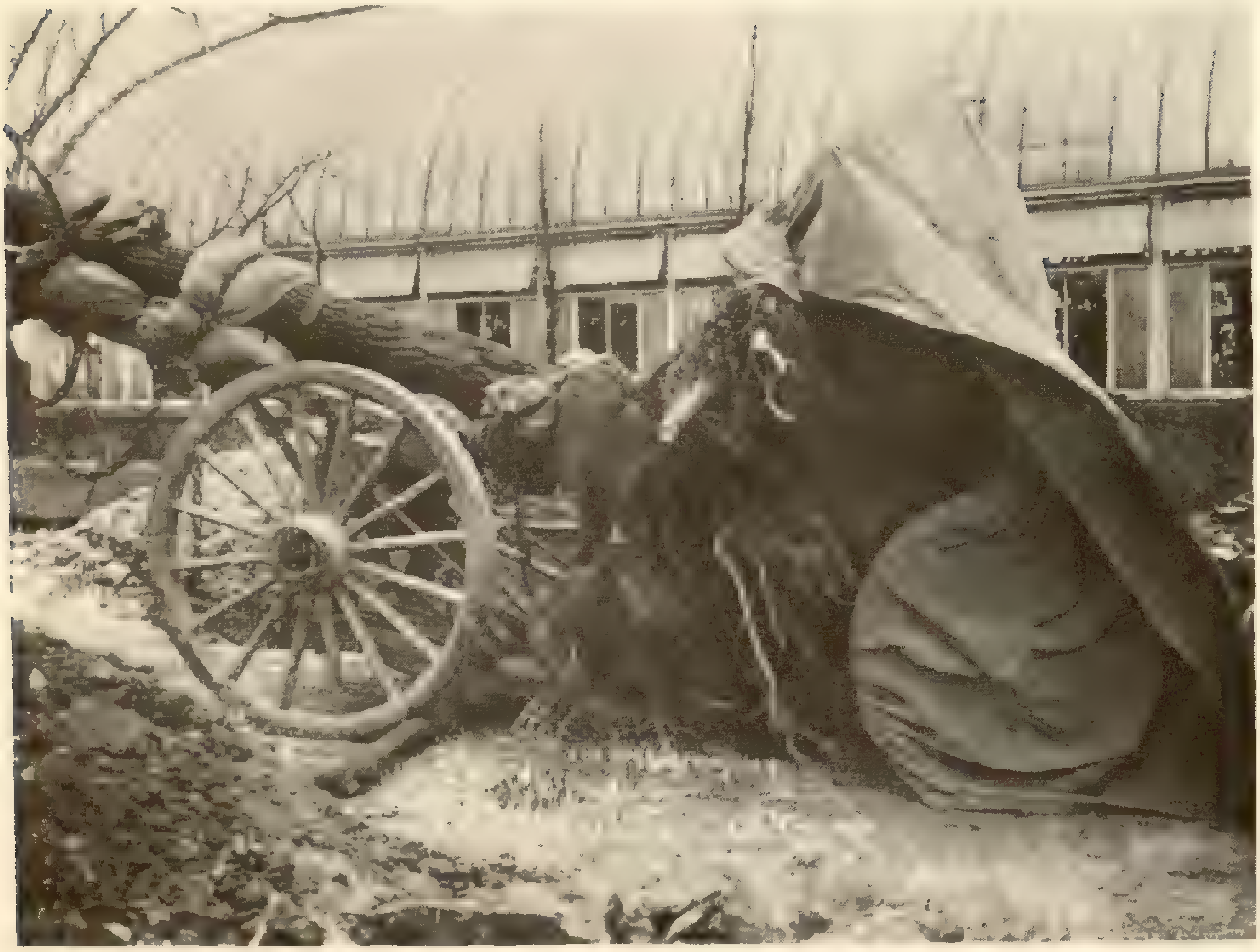
After the trench is dug to a depth of 2 feet and the boom of the truck attached, the tree is ready for tilting out of the



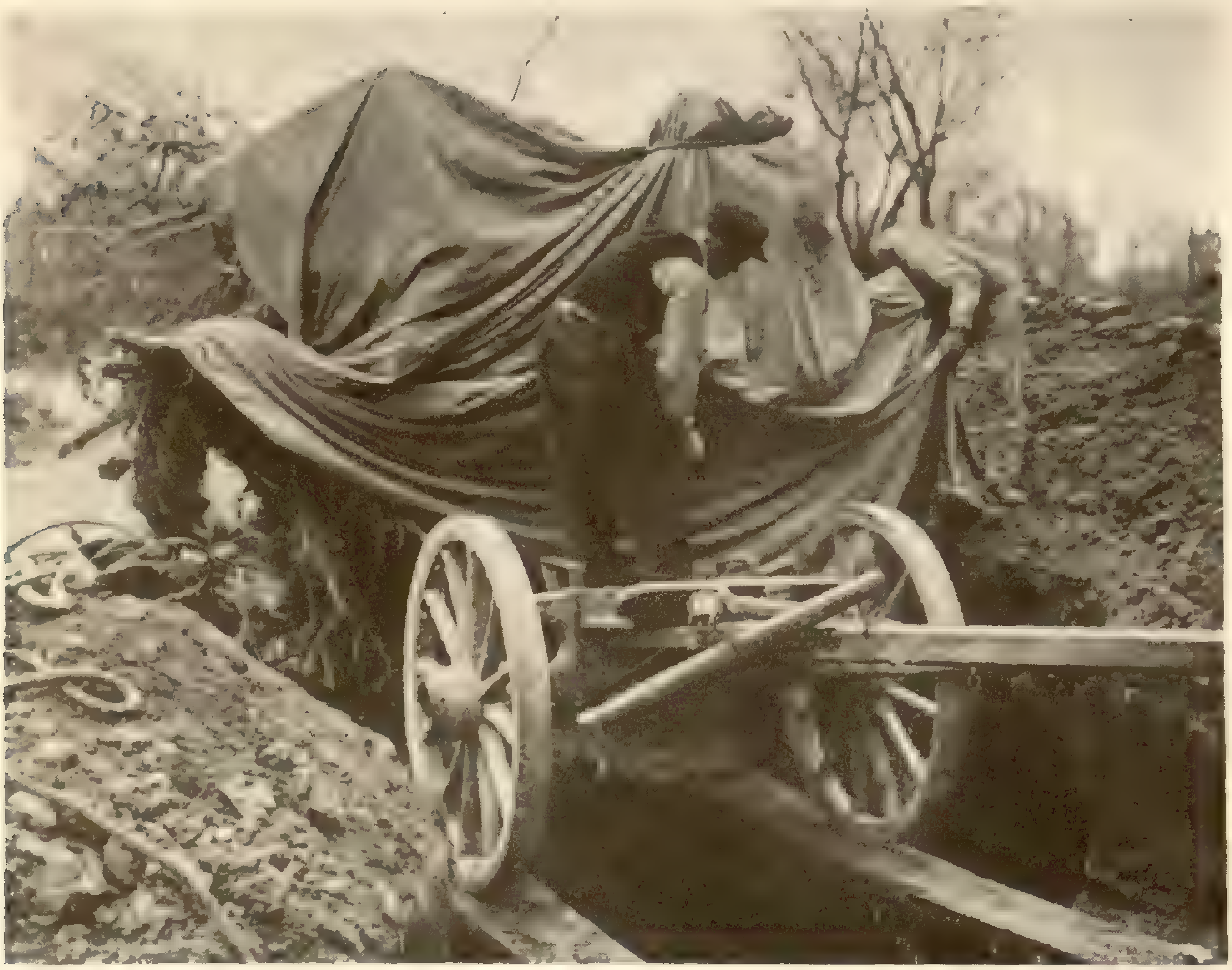
ATTACHING THE BOOM TO THE TRUNK OF THE TREE.



HAULING THE TREE OUT BY MEANS OF A WINCH.



THE TREE MOVED TO THE HOLE.



IN POSITION OVER THE HOLE. READY TO DETACH PLATFORM AND FRONT TRUCK.

hole. This is done by means of a block and pulley arrangement attached to the boom and either to another tree or a "dead man" (made by sinking a log 2–3 feet in the ground, bracing it with iron rods, attaching a chain to which the pulley is later hooked, and tamping the soil thoroughly). The power is supplied either by a team of horses or by a windlass. As the tree is gradually lifted out of its original place, some of the subsoil is removed from the bottom with round-tined forks, while the wheels of the truck are blocked to prevent slipping. As soon as tilting to a horizontal position is accomplished a heavy platform is attached to the truck, underneath the ball, and to another truck with a tongue, the entire apparatus serving the function of a low wagon, the truck with the boom and the tree constituting the rear end, while the platform acts as the body of the wagon. In this fashion the tree may be transported conveniently to its destined position. The hole for the tree should be dug somewhat larger in diameter than the ball, but no deeper, as the original depth of the roots must be secured. If the subsoil is of hard pan or heavy clay extremely retentive of moisture, a tile drain should be laid a foot below the bottom of the hole to provide proper drainage. If this is neglected death of the tree may result, due to excessive moisture causing acidity of the soil and subsequent rotting of the roots. If it is impracticable to lay a tile drain a makeshift arrangement may be made by scooping out a hole at one side of the tree hole and running a tile pipe to the surface, through which the excess water may be pumped out as rapidly as it accumulates. Poor drainage may be ameliorated also by breaking up the subsoil with 3–4 charges of ½ stick each of 20–40 per cent dynamite.

As soon as the hole is ready, two stout planks are placed over the opening at the same distance apart as the wheels of the front truck. The tree mover is then driven over these planks just far enough to place the ball in the exact position where it is to remain. The wheels of the back truck are blocked, the boom is again connected with a block and pulley to a convenient post or tree, while the front truck with the board forming the body are detached and the planks taken up. This leaves the tree attached to the boom of the back truck at the edge of the hole, into which it is lowered by means of block and pulley, the boom later being disconnected and removed. Good soil should be filled around the roots, well tamped, and watered to produce close contact between the feeding roots and the enveloping soil particles which is so necessary for proper reëstablishment of the tree. Generally, for the first year or two, it is necessary to anchor trees to prevent blowing over and to wrap the trunk with straw rope to avoid excessive transpiration and consequent drying out of the bark. A mulch of manure is desirable around the trunk to conserve moisture and furnish food. Pruning back 5–8 feet in all directions is important in order to restore the equilibrium between the roots and trunk, which is invariably disturbed because of the loss of numerous roots in transplanting.

Another machine used in tree moving operates in a somewhat different manner. It consists of a hind axle 12 feet long, with broad-tired wheels, a narrow front axle, and a frame made of 20-foot timbers which are braced to the hind axle with 10-foot three-by-fives. Two rollers are inserted into the top of the frame with a windlass at one end, by means of which the tree may be raised or lowered with large ropes passing over the rollers to the windlass. The tree is dug with a symmetrical ball and then tipped so as to permit of passing a heavy rope around a few of the large roots, leaving the ends of the rope turned up to be used later in lifting the tree. Another rope is passed in a similar manner on the other side, while 4 guy ropes are attached to the upper part of the trunk to keep it upright. The front part of the machine is then removed, the frame with the hind wheels placed around the trunk, and the front axle replaced. The back wheels are braced with timbers to aid in drawing the tree away. The ends of the rope which was fastened around the roots are now passed over the roller to the windlass, the tree slowly lifted so that it hangs within the frame, and the four guy ropes are attached to a boom underneath the frame and to the front part of the machine. Inside of the frame 4 rope loops are made fast, being so placed that by passing a rope around the trunk and through these, a ring is made which will keep the trunk in the middle and prevent bruising against the frame or the rollers. The tree is lowered into its new hole in exactly the reverse manner. In moving by this method it may be necessary to tip the tree backward in passing obstructions.

Moving trees upon a stone wagon is a simple operation, necessitating wrapping the ball in burlap and sliding it up out of the hole on to the bottom of the wagon by means of rollers placed on a wooden incline with a block and pulley arrangement.

The newest method of moving the larger trees growing in sandy soils involves the painstaking process of dissecting practically all of the roots to a diameter of 30–40 feet (for a tree 18–20 inches in diameter) and lifting them with extreme patience and skill to avoid breaking or bruising. The start is made where the roots are 1 inch thick, digging a trench 2–3 feet deep, loosening the soil down from the roots with round-pointed tines, picking out the roots and tying them in bundles. This operation is continued until a ball about 6–8 feet wide remains. This ball will vary in size, however, depending upon the size of the machine and the kind of tree. The exposed roots should be wrapped with hay or straw and covered with burlap to prevent drying out and bruising during transportation. It is fairly safe to leave the larger roots exposed for a day, as those ¼ inch or more in diameter will not be dried out to any extent within that time. The trees are lifted upon trucks or skids with a tackle, and placed in a horizontal position by means of a cradle attached to the front axle, the bundles of roots being held suspended by arms radiating from a wooden hoop around the trunk. Cushions of straw, burlap, and slats should always be used around the trunk at point of contact with tackle chains or ropes. The most important precaution in planting a tree moved in this manner is to avoid a greater depth than the original. The soil should be tamped well with round sticks, thoroughly watered, and the trees well anchored to deep anchor posts. A mulch, as well as wrapping of the trunk, is very essential to keep down excessive evaporation.

Successful transplanting of evergreens requires the retention of a ball of soil around the roots, the size of the ball varying from 3 to 15 feet in diameter, depending upon the size of the tree as well as the compactness of the root system. Root pruning and frequent transplanting of evergreens is desirable if a fibrous, compact root system is to be obtained. The ball is dug, carrying the larger roots 3–4 feet beyond it and bending these back around the ball. A canvas or burlap strip 2–3 feet wide is then placed around the mass of soil and drawn taut by means of ropes running through rings at the bottom and top of the canvas. The bottom rope is tightened with a wooden lever containing 4 holes through which the rope is passed and the lever turned. The top rope is tied and crossed. As soon as the burlap is fastened the ball is completely severed from the subsoil, and a platform placed under by tipping. The ball is then fastened to the platform and drawn out of the hole and on to a low wagon upon rollers and skids. The unloading is performed in the reverse manner, with the platform drawn into the hole and there detached and pulled out from under the tree. The canvas is then taken off, the outer roots spread out, and new soil tamped in. Shading of the trees and frequent watering will insure a greater degree of success, as the ball of soil with its roots dries out very rapidly. In California, when moving orange trees, great care is used to prevent drying out. The leaves are stripped, while the branches are tied in burlap and kept moist constantly. It is claimed to be a sure sign of failure if the flowers appear upon the trees the same year, while the appearance of new foliage without flowers spells success.

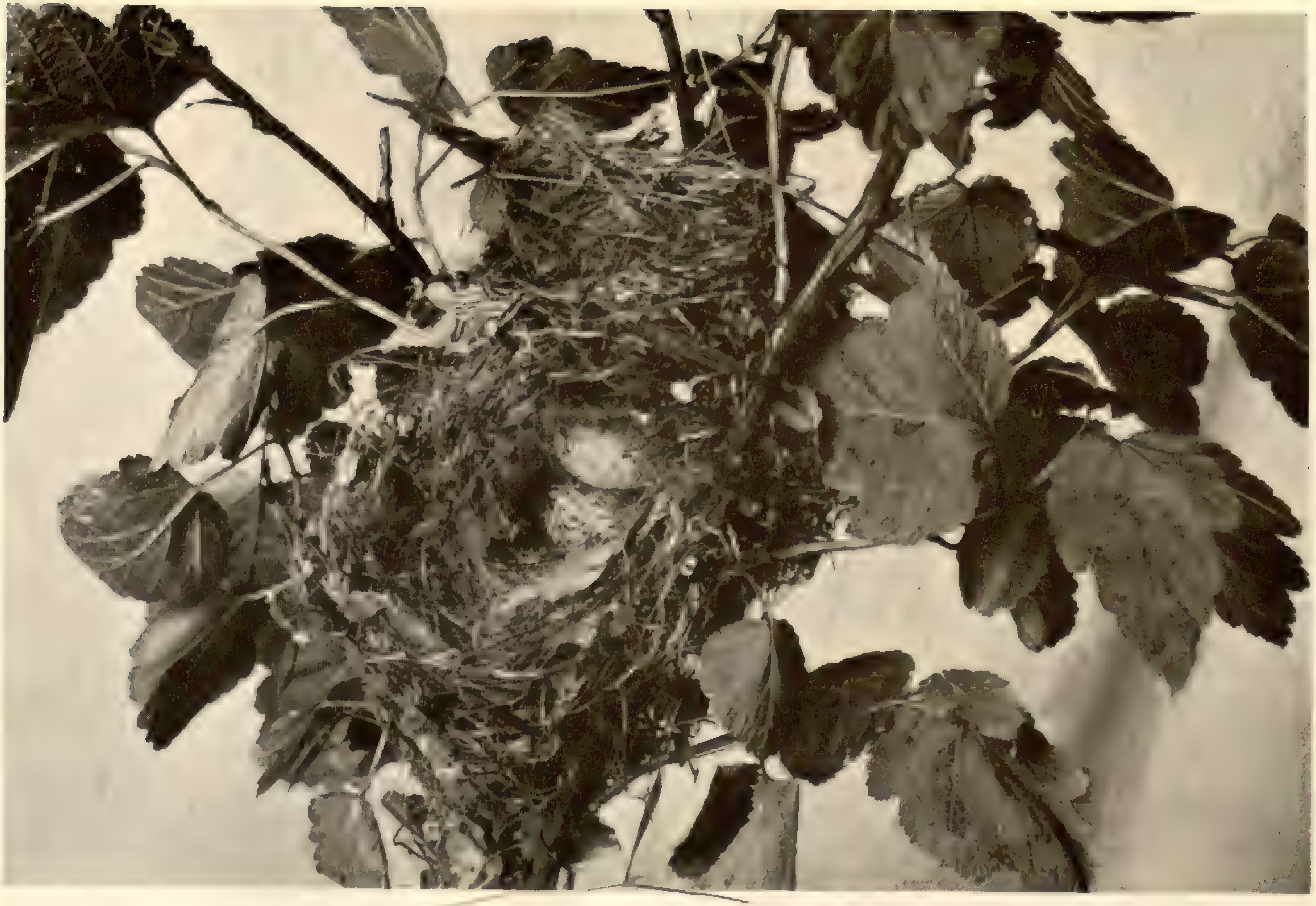
Trees may be transplanted during the winter with a frozen ball. In the fall a mulch of manure is placed around the tree 2–3 feet wider than the proposed ball. After the advent of freezing weather the mulch is removed and the ball dug gradually, allowing it to freeze. In this manner the tree is easily moved, providing a similar mulch has been placed over the new location to insure easy digging and a favorable planting condition.

BIRDS IN THE MISSOURI BOTANICAL GARDEN

The following notes on the yellow warbler and the cowbird were supplied by Mr. E. S. Daniels and Mr. George F. Tatum:

"As is well-known, the female cowbirds are feathered parasites; they build no nests of their own and deposit their eggs in nests of other birds, usually a species smaller than themselves. A notable instance is the warbler group, twenty-four species of which Chapman records as being imposed on by the cowbird. It is not unusual to find three of her eggs in the nest of a small warbler, and Chapman, in 'Birds of Eastern North America,' says that the 'ill-gotten offspring are born with the cowbird character fully developed. They eat by far the greater share of the food and through gluttony or mere size alone, starve or crowd out the rightful occupants of the nest. They accept the attention of their foster parents long after they could care for themselves, and when nothing more is to be gained, desert them and join the growing flocks of their kind in the grain fields.'

"Mr. Chapman further writes in his 'Warblers of North America' that 'only the yellow warbler appears to avoid incubating the intruded egg by building a second, and, should occasion require, a third story to its home.' Such a nest is on exhibition in the Field Museum in Chicago, and a similar one was found by the writers in the Missouri Botanical Garden during the month of May, 1917. This particular nest was an unusual one for this species to build, in that a quantity of newspaper was used in its construction. The nest was also not as compact as is usually built by the warblers,



TWO-STORY NEST OF YELLOW WARBLER, SHOWING COWBIRD EGGS.

(PHOTOGRAPHED BY MR. E. S. DANIELS.)

being very loosely constructed, and as we watched it from time to time we were fearful that the nest would fall apart before the young were old enough to leave it. When first noted it was of normal size and contained one cowbird egg which in a few days was covered by a small piece of paper. The second foreign egg was laid at a slightly higher level. Then the warbler began to work in earnest, rapidly building a thick false bottom to her nest and raising the walls. Subsequently she laid four eggs and brought off a brood of three warblers, one of the eggs evidently being infertile. The accompanying photograph shows the size and construction of the nest, which has been opened sufficiently to show both of the unhatched cowbird eggs."

NOTES

The fourth number of Volume IV of the Annals of the Missouri Botanical Garden has been issued with the following contents:

"Two Exotic Compositae in North America." J. M. Greenman.

"Algological Notes. II. Preliminary List of Algae in Devils Lake, North Dakota." G. T. Moore.

"Merulius in North America." E. A. Burt.

Dr. Mary S. Young, of the University of Texas, is spending several weeks in the herbarium working over her collection of Texas plants.

Mr. Edwin B. Payson, until recently Teaching Fellow in Botany, has entered the army service, and has been assigned to the Officers' Reserve Camp at Fort Riley, Kansas.

The public lecture at Washington University, November 26, was delivered by Dr. George T. Moore, Director of the Garden, the subject of his address being "The Evolutionary Consequences of the War."

Mr. George H. Pring, in charge of conservatories, attended the meetings of the National Gardeners' Association at Chicago, December 5–7, and gave an illustrated lecture on "The Botanic Gardens, Kew, England."

A paper on "Aquatic Gardens" by Mr. George H. Pring, in charge of conservatories, was sent to the Missouri State Horticultural Society at their convention in Kansas City, where it was read by the president, December 12.

As a result of the competitive examinations held in September, scholarships in the School for Gardening have been awarded to Miss Anne Chase of St. Louis, Mr. Frank Harris of Coffeen, Illinois, and Mr. Robert Mitchell of Gotha, Florida.

The annual meeting of the State Audubon Society was held in the graduate lecture room, December 21. In addition to the regular business meeting there was an address by Mr. Otto Widmann on "Bird Clubs and Other Societies for Bird Protection," and an exhibit of bird books, bird houses, etc. Dr. Hermann von Schrenk, Pathologist to the Garden, was elected president for the ensuing year, Mr. Ralph Hoffman, vice-president, and Dr. R. J. Terry, secretary-treasurer.

STATISTICAL INFORMATION FOR NOVEMBER, 1917

GARDEN ATTENDANCE:

Total number of visitors	68,495

PLANT ACCESSIONS:

Total number of plants and seeds received in exchange	54
Plants and seeds donated	10

LIBRARY ACCESSIONS:

Total number of books and pamphlets bought	15
Total number of books and pamphlets donated	112

HERBARIUM ACCESSIONS:

By Purchase—	
Rev. John Davis—Plants of Missouri, South Carolina, etc.	200
Mrs. R. S. Ferris—Plants of Sutter and Colusa Counties, California	112
H. Sudre—"Batotheca Europaea," Fasc. XV, Nos. 701-750	50
H. Sudre—"Herbarium Hieraciorum," Fasc. VII, Nos. 301-350	50
By Gift—	
Dr. W. H. Ballou—Fungi from White Plains	15
J. A. Drushel—Plants of the United States	17
Dr. C. F. Newcombe—Plants of British Columbia	7
New York Botanical Garden—Undetermined Thelephoraceae (235) from all parts of North America; specimens of *Merulius* (5), including parts of four types	240
E. A. Siegler—*Peniophora cinerea* from Billerica, Mass.	1
J. A. Stevenson—Fungi of Porto Rico	18
Dr. H. von Schrenk—Fungi rotting railroad ties	7
Prof. L. B. Walker—*Solenia anomala* from Nebraska	1
Mrs. A. G. Hewitt White—*Helxine Soleirolii* Req., native of Corsica and Sardinia, cultivated at Toronto, Canada	1
Dr. S. M. Zeller—*Hypochnus echinosporus* and *Odontia fimbriata*	2
TOTAL	721

The Garden is open to the public every day in the year, except New Year's, Fourth of July, Labor Day, and Christmas—week days from 8:00 A. M. until one-half hour after sunset; Sundays from December to April, 1:00 P. M. until sunset, from April to December, 2.00 P. M. until sunset.

The main entrance to the Garden is located at Tower Grove Avenue and Flora Boulevard, on the Vandeventer Avenue car line. Transfer south from all intersecting lines.

Index to Illustrations

Page
Entrance, an effective arrangement for........................... 27
Window boxes, arrangements for.......................28, 30, 31
Window boxes, effective, in department store, Boston............. 32
Flower and vegetable garden, plan of............................ 41
Shrubbery and perennial garden, plan of......................... 42
Rose garden, plan of.. 43
Subtropical garden, plan of..................................... 44
Massachusetts Agricultural College, floricultural work at........ 48
Vegetable garden, suggestive plan of............................ 67
Tree in need of repair.. 91
Tree trunk, cross section of.................................... 92
Tree surgery, operations in.........................91, 92, 94, 96
Floricultural work of students at Garden...................107, 110
Drafting and surveying work of students at Garden.............. 108
Landscape designs by Garden students............................ 112
Coprinus atramentarius 119
Coprinus comatus and *C. micaceus*............................ 120
Pleurotus ostreatus 122
Lepiota naucinoides 124
Agaricus campestris 124
Amanita phalloides 125
Hydnum coralloides 126
Calvatia cyathiformis 128
Chrysanthemum and stevia, effect of smoke on.................... 160
Cineraria and *Begonia semperflorens*, effect of smoke on........ 161
Transplanting trees, operations in..................167, 168, 169
Tree, a large, being prepared for moving....................... 168
Yellow warbler, two-story nest of, showing cowbird eggs........ 172

General Index

Figures in italics refer to page numbers of plates and cuts

A.

Acanthophoenix crinita, 136; *rubra*, 136

Acanthorhiza aculeata, 136; *Warscewiczii*, 136

Acer, transplanting of, 167

Acoelorrhaphe arborescens, 136

Agaricaceae, 121; with black spores, 121; with white spores, 124

Agaricus campestris, 123, *124*, 125

Agathis loranthifolia, 97, 136

Agricultural schools, 50

Air circulation as a factor in storage of vegetables, 81

Allamanda Williamsii, 136

Alpinia nutans, 136

Alumni Association of the School for Gardening: greetings from the president of the, 49; notice of 1917 meeting of, 60

Amanita phalloides, 125, *125*

Anchovy pear, see *Grias cauliflora*

Annual reports for 1916: of the Officers of the Board, 1; of the Director (twenty-eighth annual report), 4

Anthocyanins, 134

Araucaria Bidwillii, 97; *braziliana*, 97; *excelsa*, 97; *imbricata*, 97

Archontophoenix Cunninghamii, 136

Arenga saccharifera, 137

Arnold Arboretum. Plants of China and Japan, 25

Asparagus plumosus, 98; *Sprengeri*, 98

Aspidistra elatior var. *variegata*, 137

Astrocaryum mexicanum, 137

Attalea Cohune, 137; *speciosa*, 137

Autumn foliage, 133; red pigments in, 134; yellow pigments in, 134

B.

Back-yard gardens, 33; plans of four typical, at Garden, *41*, *42*, *43*, *44*; plants to be used in, 37

Bactris major, 137

Bamboo, see *Bambusa arundinacea*

Bambusa arundinacea, 137

Bartholomew, E. "Fungi Columbiani," Cent. XLIX, L and LI, Nos. 4801–5100, 79; "North American Uredinales," Cent. XVII, Nos. 1601–1700, 90

Beans, storage of, for winter use, 82; harvesting of seed, 85

Beets, storage of, for winter use, 83

Begonia nelumbiifolia, 138; *semperflorens*, affected and healthy plants, *161*

Bignonia argyreo-violascens, 138; *Clytostoma* var. *callestegioides*, 138; *venusta*, 138

Bird-of-Paradise flower, see *Strelitzia Reginae*

Birds in the Missouri Botanical Garden, 172; observed during April, 78, 88; during May, 88

Blach, W. E. Photographs of orchids of Vermont, 63

Bogula, Otto. Commercial floriculture in England vs. the United States, 54

Boletus edulis, 126

Books for soldiers, 129

Botany, courses in, offered at School for Gardening, 108

Bougainvillea glabra, 138

Bowenia spectabilis var. *serrulata*, 98

Brahea calcarea, 138

Bulbs: planting of, in England, 55; treatment of, for forcing, 147

Bunya-bunya, see *Araucaria Bidwillii*

Burke, Dr. R. P. Fungi of Alabama, 156, 165

Bush, B. F. Plants of Missouri, 90

Business districts, need for floral decoration in, 27

C.

Cabbages, storage of, for winter use, 82

Calendula, 161

Calvatia cyathiformis, *128*

Canning vegetables, 73; apparatus used in, 75; directions for, 75

Canton Christian College. Plants of China, 143, 165

Carludovica latifolia, 138; *palmata*, 138

Carotins, 134

Carrots, storage of, for winter use, 83

Caryota mitis, 138; *Rumphiana*, 138

Cauliflower, storage of, for winter use, 82

Celery, storage of, for winter use, 82

Ceratozamia mexicana, 98, var. *longifolia*, 98; *Miqueliana*, 98; *terrestris*, 98

Ceroxylon andicolum, 138

Chamaedorea bambusoides, 139; *corallina*, 139; *Ernesti-Augusti*, 139; *oblongata*, 139; *sp.*, 139

Chamaerops humilis, 139

Chrysalidocarpus lutescens, 139

Chrysanthemums, healthy and affected, *160*

Cineraria, healthy and affected, *161*

Clavariaceae, 126

Clokey, Ira W. Plants of Texas, collected by Mr. and Mrs. J. Clemens in 1911, 79

Cocos Arechavaletana, 139; *australis* 139; *flexuosa*, 139; "Marie Rose," 139; *nucifera*, 139; *plumosa*, 139; *Romanoffiana*, 139

Collins, F. S. "Phycotheca Boreali-Americana," Fasc. XLIV and XLV, Nos. 2150–2250, 130

Construction, courses in, offered at School for Gardening, 109

Coprinus, 121; *atramentarius*, *119*, 122; *comatus*, *120*, 122; *micaceus*, *120*, 123

Coquito nut, see *Jubaea spectabilis*

Corn, method of curing, for seed, 85

Cowbirds, 172

Crawford, D. L. Plants of Nicaragua, collected by C. F. Baker in 1903, 79

Cupressus Corneyana, 98; *glauca*, 98; *sempervirens*, 99; *thurifera*, 99

Curculigo recurvata, 139

Cycad house, plants in the, 97

Cycas circinalis, 99; *media*, 99; *revoluta*, 99; *tonkinensis*, 99

Cyperus alternifolius, 99

Cypripedium insigne var. *Sanderae*, 161

D.

Daemonorops palembanicus, 140

Damage to greenhouse plants at Garden due to smoke, 160

Dammar, see *Agathis loranthifolia*

Daniels, E. S., and Tatum, George F., notes by, on yellow warbler and cowbird, 172

Date, Canary Islands, see *Phoenix canariensis*

Davis, J. J. "Fungi Wisconsinenses Exsiccati," Decades III and IV, Nos. 21–40, 106

Davis, Rev. John. Plants of Missouri, 47, 117, 130

Degrees awarded to graduate students in 1916, 14

Deutzia, forcing of, 146

Development of a small place, lecture course on the, 154

Dictyosperma rubra, 140

Dieffenbachia Seguine, 140

Dioon edule, 99; *spinulosum*, 100

Diseases of plants, 72

Dracaena fragrans var. *Massangeana*, 140

Drafting room at School for Gardening, *108*

Drainage for transplanted trees, 169

Drying as a means of forcing plants, 145

Dulau & Co. "Hepaticae europaeae," Dec. I–LXVI, von Gottsche & Rabenhorst, 63

Dumb-cane, see *Dieffenbachia Seguine*

E.

Elaeis guineensis, 140

Encephalartos Altensteinii, 100; *caffer*, 100; *Hildebrandtii*, 100; *horridus*, 100; *lanuginosus*, 100; *villosus*, 100

Ends and walls, some practical observations on, 58

England, commercial floriculture in, 54

Entrance, an effective arrangement for an, *27*

Erythea armata, 140; *Brandegeei*, 140; *edulis*, 140

Ether as an agent for forcing plants, 145, 146

Eucalyptus globulus, 100; *rostrata*, 100; *melliodora*, 101

Euphorbia lutescens, 157; *pulcherrima*, 157, var. *alba*, 158, var. *albida*, 158, var. *plenissima*, 157; *salmonea* var. *Adneti*, 157

Evergreens, transplanting of, 171

F.

Farlow, W. G. Algae and lichens from various localities, 106; Fungi from various localities, 117
Fern: asparagus, see *Asparagus plumosus;* Boston, see *Nephrolepis exaltata* var. *bostoniensis*
Fern house, plants in the, 162
Fertilizers, 69
Ficus pseudopalma, 141; *repens,* 101
Fig, creeping, see *Ficus repens*
Fittonia argyroneura, 141; *gigantea,* 141
Floral display for December, 161
Floricultural education, 50
Floricultural work: at Massachusetts Agricultural College, *49;* of students at Garden, *107, 110*
Floriculture, commercial, in England vs. the United States, 54
Florists' telegraph delivery association, 57
Florists' stores, retail, 55; advertising of, 57; buying for, 55; salesmanship in, 56; special days at, 56
Flower and vegetable garden for a back yard, description of a, 33; plan of, *41;* plants used in, 37
Flower show, St. Louis, prizes awarded to Garden at, 61
Fogs, 160; conditions accompanying, 160; injuries to plants caused by, *160, 161;* list of plants at Garden injured by, 161
Forcing plants and twigs, 145
Forsythia, forcing of, 146
Fraxinus, transplanting of, 167
Freezing as a means of forcing plants, 145
Freiberg, G. W. Plants of Washington, 106

G.

Gardening, School for, 107; beginning of, 52; courses of instruction in, 108, 110; officers of administration and instruction, 110; report of, for 1916, 9; schedule of afternoon work, 113; scholarships offered at, 115; system used at, 52
Gaussia princeps, 141
Germination test for seed, 86
Golden-bell, see Forsythia
Greenhouses, building of, 58
Grias cauliflora, 141
Gross, A. R. Notes from the secretary's desk, 60
Grout, A. J. "North American Musci Pleurocarpi," Nos. 457–475, 79
Gum: blue, see *Eucalyptus globulus;* honey-scented, see *Eucalyptus melliodora;* red, see *Eucalyptus rostrata*

H.

Hakea varia, 101
Herbarium, report of, for 1916, 19; distribution of duplicates, 21; field work during 1916, 21; important accessions during 1916, 20; mounting and distribution of specimens, 20
Holzinger, J. "Musci Acrocarpi Boreali-Americani," Nos. 351–375, 106
Horticulture, courses in, offered at School for Gardening, 108
Hottentot's head, see *Stangeria paradoxa*
House, Dr. H. D. Thelephoraceae and other fungi of New York, collected by Dr. C. H. Peck, 143
Howea Belmoreana, 148; *Forsteriana,* 148
Hydnaceae, 126
Hydnum coralloides, 126
Hydriastele Wendlandiana, 148
Hydrochloric acid as an agent for forcing plants, 145
Hyophorbe Verschaffeltii, 149
Hypholoma appendiculatum, 123; *Candolleanum,* 123

I.

Ilex opaca, transplanting of, 167
Ink caps, see Coprinus
Insects, control of, 71
Instruction, courses of, offered at the Shaw School of Botany during 1915–16, 10

J.

Jacquinia pungens, 101
Jörgensen, Pedro. Plants of Argentina, 25, 117
Jubaea spectabilis, 149

K.

Kafir bread, see *Encephalartos Altensteinii*
Kellogg, John. Private herbarium, consisting of plants of Missouri, Arkansas, Texas, California, etc., 117

Kentia Macarthurii, 149; *Sanderiana*, 149

L.

Land-grant college, 51
Landscape architecture, courses in, offered at School for Gardening, 109
Landscape designs by Garden students, *112*
Latania aurea, 149; *Commersonii*, 149; *Loddigesii*, 149
Lecture course on the development of a small place, 154
Lectures delivered by members of staff in 1916, 10
Lepiota naucinoides, 124, *124*
Levine, C. O. Plants of China, 130
Library, report of, for 1916, 22; card index to mycological exsiccati, 23; Garden publications as a means of exchange, 23; loans of books, 23; progress of subject index, 24; reclassification of books, 23
Licuala grandis, 149
Lilac, forcing of, 146
Liquidambar Styraciflua, transplanting of, 167
Liriodendron tulipifera, transplanting of, 167
Livistona australis, 149; *chinensis*, 149; *rotundifolia*, 149
Long, Dr. W. H. Timber-destroying fungi of Merulius and genera of the Thelephoraceae from Texas, New Mexico, and Arizona, 131
Lycoperdaceae, 127

M.

Macrozamia Moorei, 101; *Paulo-Guilielmi*, 101; *spiralis*, 101
Magnolias, transplanting of, 167
Marchantia polymorpha, 101
Marigold, pot, see Calendula
Martinezia caryotaefolia, 149
Massachusetts Agricultural College, horticultural work at, 51; perennial garden at, planted by students, *49;* students studying varieties at, *49*
Millspaugh, Dr. C. F. Plants of Yucatan, collected by Dr. C. F. Gaumer, 47
Mohr, Rudolph J. Retail florists' stores, 55
Moisture as a factor in storage of vegetables, 81
Monkey puzzler, see *Araucaria imbricata*
Monstera deliciosa, 150
Moss, club, 102, 153
Mushrooms, native wild, for food, 119; food value and preservation of, 129

N.

Narcissus, 161
Nehrling, Arno H. Floricultural education, 50; Greetings from the president of the alumnae association, 49
Nelson, Prof. Aven. Plants of Alaska, collected by Mr. and Mrs. Ernest P. Walker, 143; Plants of Idaho, collected by MacBride & Payson, 143
Nephrolepis exaltata var. *bostoniensis*, 102
Norton, J. B. S. Plants of Maryland, 90
Notes from the secretary's desk, 60

O.

Onions, storage of, for winter use, 83; production of seed, 85
Ophiopogon japonicus, 102
Orchid, cattley, 161; slipper, 161
Oreodoxa regia, 150
Overholts, L. O. Fungi of Colorado, 117

P.

Palm: blue, 140; broom, 153; cocoanut, 139; Cohune, 137; curly, 148; date, 150; fern, 99; fish-tail, 138; flat-leaf, 148; hemp, 153; nut, 99; oil, 140; panama-hat, 138; prickly date, 136; royal, 150; sago, 99; silver-thatch, 153; sugar, 137; thatch, 153; wax, 138; weeping, 154
Palm house, plants in the, 136, 148
Palmer, E. J. Plants of Missouri, Arkansas, Louisiana, Oklahoma and Texas, 25
Palmetto, cabbage, see *Sabal Palmetto;* royal, see *Sabal Blackburnianum*
Panaeolus, 122
Pandanus caricosus, 150; *utilis*, 150; *Veitchii*, 150
Parsnips, storage of, for winter use, 83
Passiflora edulis, 102
Passion-flower, see *Passiflora edulis*
Pawpaw, melon, 161
Pellionia Daveauana, 102

Perennials, herbaceous, treatment of for forcing, 147; list of, 148
Philodendron sagittifolium, 150
Phoenix canariensis, 150; *dactylifera*, 150; *paludosa*, 151; *pumila*, 151; *reclinata*, 151; *Roebelenii*, 151; *rupicola*, 151; *sylvestris*, 151
Pine, Norfolk Island, 97; screw, 150
Pithecoctenium muricatum, 151
Pleurotus ostreatus, *122*, 124; *sapidus*, 124; *salignus*, 124
Podocarpus japonica, 102; *neriifolia*, 102
Poinsettia, the, 157; culture of, 158; insect pests of, 159; use of, 158
Poinsettias, 161
Polyporaceae, 126
Potatoes, 72; best varieties of, 73; directions for planting, 72; storage of, for winter use, 83; sweet, storage of, 83
Pritchardia Gaudichaudii, 151; *Martii*, 152; *pacifica*, 152
Pruning transplanted trees, 170
Ptychosperma elegans, 152
Publications and papers published by the staff and graduate students during 1916, 15
Puff-balls, see Lycoperdaceae

Q.

Quercus, transplanting of, 167
Quinine plant, 161

R.

Rattan, see *Rhapis flabelliformis*
Ravenala madagascariensis, 152
Research and instruction, report of, for 1916, 10
Rest-period of plants, 145; agents used in breaking or shortening, 145; stages of, 146
Rhapis flabelliformis, 152; *humilis*, 152
Rhopalostylis sapida, 152
Rose garden for a back yard, description of a, 34; plan of, *43*; plants to be used in, 39
Roystonea (*Oreodoxa*) *Borinquena*, 152
Rufus J. Lackland fellowships, appointments to, for 1916, 13

S.

Sabal Adansonii, 153; *Blackburnianum*, 152; *glaucescens*, 153; *havanensis*, 153; *mauritiaeformis*, 153; *Palmetto*, 152
von Schrenk, Dr. Hermann. Plants from the herbarium of Prof. Joseph Schrenk, 131; Plants of Europe collected by G. Hieronymus chiefly in Silesia, 106
Seed for 1918, 84; method for harvesting, 84; selection of, 84; time for harvesting, 84
Selaginella cuspidata, 102; *denticulata*, 153; *Martensii*, 153
Shell flower, see *Alpinia nutans*
Shrubbery and perennial garden for a back yard, description of a, 34; plan of, *42*; plants to be used in, 38
Shrubs for forcing, treatment of, 146; list of, 147
Smith, Arthur H. Some practical observations on ends and walls, 58
Smoke, damage to greenhouse plants at Garden due to, 160, *160*, *161*; list of plants injured by, 161
Snake's beard, see *Ophiopogon japonicus*
Soil, preparation of, for planting, 68
Solanums, 161
Spiraea, forcing of, 146
Squashes, storing of, for winter use, 83
Stangeria paradoxa, 102
Statistical information for December, 1916, 25; January, 1917, 47; February, 63; March, 79; April, 90; May, 106; June, 117; July, 130; August, 143; September, 156; October, 165; November, 174
Stevia, 161; healthy and affected plants, *160*
Storage of vegetables, 81; in cellars, 81; in cold-frames, 82; in pits, 82
Strelitzia augusta, 153; *Reginae*, 153
Subtropical garden for a back yard, description of a, 34; plan of, *44*; plants used in, 39
Sulphurous acid, injury to plants caused by, 160
Surveying at School for Gardening, *108*; courses offered in, 109

T.

Tartaric acid as an agent for forcing plants, 145
Tatum, George F., and Daniels, E. S., notes by, on cowbird and yellow warbler, 172
Taxodium mucronatum, 102; *distichum*, transplanting of, 167

Temperature, most favorable, for storage of vegetables, 81

Thrinax argentea, 153; *excelsa,* 153; *Morrisii,* 153; *multiflora,* 153; *parviflora,* 153; *radiata,* 153

Thunbergia fragrans, 153

Tomatoes, storage of, for winter use, 84

Trachycarpus excelsus, 153

Transplanting trees, 167; ball-of-earth method of, 167, operations involved in, 167, *167, 168, 169,* machines used in, 167, 169; newest method of, 170, operations involved in, 171, equipment used in, 171

Traveler's tree, see *Ravenala madagascariensis*

Tree surgery, 91; bracing, 96; materials employed in, 94; steps in, *91, 92,* 94, *94, 96*

Trees: care of, 91; cross-section of trunk, *92;* functions of various parts, 91; transplanting of, 167; treatment of wounds, 92

Turnips, storage of, for winter use, 83

U.

Ulmus, transplanting of, 167

Umbrella plant, see *Cyperus alternifolius*

V.

Vegetable garden, the spring, 65; buying of seed for, 69; control of insect enemies, 71, of plant diseases, 72; cultivation of, 71; planting of, 66, 69; preparation of soil for, 68; suggestive plan of, *67,* varieties and amounts for, 66; the fall, 72

Vegetables, storage of, 81

Vorhies, Chas. T. Plants of Arizona, 90

W.

Wandering Jew, see *Tradescantia zebrina* var. *tricolor*

Warbler, yellow, 172; nest of, *172*

Washingtonia filifera, 154; *Sonorae,* 154

Weevil plant, see *Curculigo recurvata*

Window boxes, a type of floral decoration applicable to down-town districts, 27; advantages of, 27; arrangement of, 28; conditions for, 28; effect of, on department store, *32;* plants used in, *28,* 29, *30, 31;* types of, 31

X.

Xanthophylls, 134

Z.

Zeller, Dr. S. M. Plants of Washington, 165

STAFF
OF THE MISSOURI BOTANICAL GARDEN

Director,
GEORGE T. MOORE.

Benjamin Minge Duggar,
Physiologist in charge of Graduate Laboratory.

Hermann von Schrenk,
Pathologist.

Jesse M. Greenman,
Curator of the Herbarium.

Edward A. Burt,
Mycologist and Librarian.

Anne W. Davis,
Research Assistant.

Katherine H. Leigh,
Secretary to the Director.

James Gurney,
Head Gardener, *Emeritus.*

John Noyes,
Landscape Designer.

Alexander Lurie,
Horticulturist.

J. J. Coughlin,
Construction.

P. Foerster,
Farm and Stables.

W. F. Langan,
Engineer.

G. H. Pring,
Conservatories.

H. Vallentine,
Carpenter.